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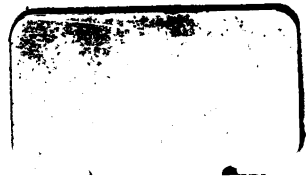
A GUIDE TO

TECHNICAL WRITING

T. A. Rickard

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A GUIDE

TO

TECHNICAL WRITING

— BY —
T. A. RICKARD

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PREFACE.

This little book is intended to help those who wish to write clearly on technical subjects. My experience in professional writing is not long enough to have entailed loss of sympathy with beginners, yet it is sufficient to have taught me the value of a guide in these matters. Rules are useful, but the understanding of the reason on which a rule is based is better. No man can apply a rule intelligently until he understands when to disregard it. Such hints as I have put together are those suggested by daily practice as an editor; they claim no finality; all of them may not prove acceptable; but if they provoke greater attention to the fundamentals of good technical writing, this essay will have accomplished a useful purpose.

T. A. RICKARD.

San Francisco, May 1, 1908.

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INTRODUCTORY.

It has been said that in this age the man of science appears to be the only one who has anything to say, and he is the one that least knows how to say it. This applies with particular force to the technical expert, whose science is utilitarian and who, therefore, even more than the philosopher, is inclined to disregard the help of correct literary expression. In fact, the suggestion of attention to such minor matters is apt to be considered merely an irritating emphasis on a non-essential. The editor of a Denver mining paper felt assured of support when he expressed the opinion that attention to the niceties of literary form was a mere "frill"; all that was needed was "to get there," that is, to say what you mean in your own way. This view of the matter receives endorsement, in deed rather than in theory, from many writers on technical subjects. Moreover, the men of the mining and metallurgical professions are usually too busy to write leisurely, and in their hurry they are apt to be heedless of the qualities that enable language to fulfill its purpose.

Herein lies the root of the matter. Language is a vehicle of expression designed to convey ideas from one man to another. It was not intended for the soliloquy; civilized man does not live by himself, nor does he talk to himself. The spoken word is heard by those present; the written word reaches those at a distance; the printed word is intended to be read by thousands. Careful composition facilitates the conveyance of ideas, the primary purpose of writing being to transfer ideas from one man to

another in such a manner as to give the least trouble to the recipient. At best human speech is a clumsy vehicle of thought; much of the idea is lost in transit; too much energy is consumed in the effort to arrive at the mental destination. Obviously we should endeavor to make the transfer as complete and as direct as possible. Conscientious writers try to improve their mode of expression by precision of terms, by careful choice of words, and by the arrangement of them so that they become efficient carriers of thought from one mind to another. Careless scribblers do not trouble themselves either to be precise in their terms or nice in the selection of words; they deem themselves hindered in the freedom of their speech by the rules of grammar; they regard form as a fad. As the Denver critic said, they "want to get there." But that is exactly what they fail to do, for "getting there" means the successful conveyance of ideas from their minds to those of their readers, and this they are unable to do because their terms do not describe the things they refer to, their arrangement of words is turbid, their sentences are involved, in fine, their vehicle of thought does not perform its proper function. It is as if a man wanting to transport a load of potatoes from his farm to the nearest town, were to put them, not in sacks, but loosely, into a wagon that needs repair, and then took any road that offered, driving without regard to ruts or stones, but rapidly and carelessly—just to get there—without wasting thought as to the manner of the performance or attempting to put on any style—just get there—at any time, in any way—while the potatoes get shaken and bruised, some fall out of the wagon, and the few that survive are hardly worth cooking. Another farmer with

a little more sense, puts his potatoes in sacks; he lays the sacks so that they rest securely in his wagon, the wheels of which are well oiled and all the gear in excellent running order. He takes the most direct way, avoids obstacles, drives with a light but firm rein, keeping his eye on the road, and without loss of time delivers his potatoes in first-class condition to the nearest market. You can vary the parable and you can add to it many details illustrating different phases of this subject.

Among professional men the idea seems to prevail that a technical paper at its best is bound to be dry and that it is of no particular consequence how it is written as long as it is free from errors of fact and inference. To many of them the evidence of finish in the diction or of charm in the treatment savors of a sort of literary effeminacy, the introduction of an element foreign to the subject and calculated to weaken the force of a statement. Of course, it is possible to spend so much energy on the manner of writing as to dilute the matter almost to extinction, as a man can be so careful about the choice of his wagon and the selection of his road that he fails to reach the market with his load of potatoes until after dark. But technical writers rarely err in this way; on the one hand the subjects they choose do not lend themselves to rhapsodies, and, on the other, the careful use of the pen tends to crystallize thought, producing simplicity, so that the clearness of the writing is due not to the poverty in ideas but to the precipitation of them.

It being granted that writing is an instrument for transmitting ideas, we can appeal to the engineer on the score of efficiency — the fetish before which he bows continually. It might be expected that he would

try to make his writing as efficient as possible. All his training is toward precision, and in his daily work he recognizes the need of the right thing in the right place; nevertheless, in his writing he is prone to employ terms of precision with all the carelessness of a boy in the new possession of an air-gun. Although he writes continually, whether it be reports, specifications, or letters, he is apt to consider the mode of expression as too academic for practical purposes. One consequence of this indifference is that those who know him only by his written records are apt to undervalue his ability.

Science is organized common sense. Is it sensible to take great pains in developing ideas and then to be careless in the transfer of them? If not, then the scientific man is unscientific in his writing. Not that I would rate the manner above the matter; for we all know people with a fatal facility for expression; they have nothing in particular to say, so they write for the daily press. But in technical and scientific literature, whether of periodicals or of books, the complexity of the subject is permitted to kill the charm of the writing and it would seem as if the worth of the matter were considered so great as to make the manner of presenting it a superfluity. This is done despite a general appreciation of the value of art in writing. Two examples may be quoted from among great writers. In Ruskin the wording is so exquisite that the science is secondary. Take the fourth volume of 'Modern Painters' and read his description of the mica schist on the top of the Matterhorn; it has the charm of poetry, and the cadence of music, even if it be not orthodox geology. Then turn to Huxley and read his essay on a bit of coal; there the description is clear and the

exposition luminous, science and art are wedded in an essay the form of which is as perfect as the work of an artist; the thought, as profound as the utterance of a sage. That is indeed scientific literature.

While engineers and geologists have had to burden their library shelves with a lot of half-baked material, and while they often suffer from mental dyspepsia by reason of the chunks of knowledge, without dressing or *garniture*, placed before them, they have reason also to be grateful for some dishes of technical information, well-cooked, served with *sauce piquante*, and adorned with the parsley of pleasant fancy. To Rossiter W. Raymond, Henry M. Howe, and Edward D. Peters, for example, we are indebted for luminous literature sufficient to demonstrate that technology is not necessarily a desert of dry things. In geology the scope is wide, for the fairy wand of the constructive imagination is waved over the musty page and awakens the imagery of art, irradiating the library of the scientific man like those parterres of brightly tinted flowers that spring into sudden life after the rain has fallen on the West Australian desert. Among the living authors on geology to whom we owe a memorable amount of delectable reading are John W. Judd and Archibald Geikie in England, while in America there are a number skilled in this regard, notably S. F. Emmons and F. L. Ransome. If the geologists are ahead of the mining engineers and metallurgists in felicity of expression, it is largely due to the fact that most of them have undergone an academic training before taking a special course in science; consequently, they have acquired some feeling for the proper use of language and a command of words that practice has cultivated.

It is not for me to say much about style, for even the definition of this term involves elaborate analysis. The technical writer may well begin by trying to learn the use of "proper words in proper places," that is, effective expression obtained by precision, in order that the writer may economize the mental labor of the reader. After a while he may acquire such skill that his words convey more than their dictionary meaning and on rare occasions he may even weave a beautiful fabric illustrating the complete harmony of thought and expression. But the first principle of style is to say a thing so that it is understood. Then out of the several ways in which an idea can be stated, choose the particular way that will make it bite into the understanding of the reader. If you describe a stamp-mill to an experienced millman, a mining student, or a bishop, you will vary the manner of telling. The most effective will be that which has a sympathetic appreciation of the other fellow's receptiveness. Do not plant carnations in a clay soil, or rice in a sand heap. As a rule the process is simplified by the fact that technical writings are intended to be read by technical students and, there being an accord between the writer and his readers, he can adopt a uniform manner, namely, that which is natural to the professional man when dealing with professional matters. Therefore the "great art" of Pater, the "inevitable phrase" of Raleigh, or the "personal style" of Symonds are alike in bad taste, because they are out of place. They are not fitting. On the contrary, the ideal is Spencer's "economy" of time and words by saying what there is to say so that it cannot be misunderstood.

Technical writers should take two precepts as their

guide: First the "proper words in proper places" of Swift; and then, "the style is the man" of Buffon; that is, precision and sincerity. Affectation is the worst of faults. It is a compliment to a writer to be told that he writes as he talks, always supposing that he does not talk wildly or carelessly. We like those who are natural and that is why the most effective writing is natural. There are those who, when they prepare matter that is to be printed, affect a vocabulary and an idiom foreign to them, just as some queer persons have society manners as distinguished from their behavior at home. There are public occasions, of course, when a certain dignity of bearing is befitting; for similar reasons it is proper that the irresponsibility and ease of ordinary talk should be modified when making statements for print. On the whole, if mining engineers, metallurgists, and geologists were to write their articles as letters to an honored professional friend, the result would be satisfactory.

Bad writing is due to two fundamental errors: on the one hand, entire disregard for the manner of expression, as though it were of no consequence; and on the other, subordination of the matter to the manner. The first was illustrated by the Denver editor* already quoted; the second is typified by the stylists, who wrote with a skill far beyond anything worth the saying that they had to say.

Write simply and clearly, be accurate and careful; above all, put yourself in the other fellow's place. Remember the reader. Fluency of diction, largeness of

*He has laid down the pen and is now less like a bull in a china shop; whether he wields the sword or the hoe does not greatly matter.

vocabulary, ease of execution, and the distinction of a particular manner, if they come, will come with practice.

Young engineers—and even some of the older ones—have been known to express the desire to be able to write like Dr. Raymond, for example, evidently thinking that it is a sort of heaven-sent faculty or else something of a trick, the clue to which they might discover. I venture to say that in writing, as in many other things, it is practice that makes perfect. You will find that the men whom you regard as skillful with the pen are those who have written a great deal, even if they have not published all of it. Raymond writes with a pen or pencil, usually the former, because the rigidity of the pencil is more fatiguing to the hand than the elasticity of a pen. What he writes is subsequently typewritten, of course, but by writing himself in long hand he is able to look over the first draft as a whole, and make such corrections as will avoid the necessity for a second typewritten version. At the same time it must be added that he dictates business letters and he can dictate a long article or even legal testimony, punctuation included. Skill in any department of human activity is apt to be the result of taking pains, and writing is no exception.

Constant dependence upon a stenographer tends to repetition and lack of lucidity. It is no wonder that the technical men who are dependent upon a stenographer do not acquire a satisfactory manner of writing; for many of them only put their pen to paper in order to make a signature. When dictating, a man does not have the opportunity to see what he has just said, to note how it hangs together, to cull and to correct as he proceeds until the entire statement expresses his exact meaning.

It is certain that dictation makes for diffuseness and repetition. Herbert Spencer's experience was that after he employed an amanuensis his writing became prolix. In his later volumes he could cut out a quarter or more, whereas in the earlier books the texture was so close as to render condensation unnecessary. On the other hand, the use of a typewriting machine by an author is open to less objection and obviates some of the dangers of dictation, although it does not afford quite the same facility for correction as the pen or pencil. As a matter of practical suggestion, I venture to urge those who care to write well that they should re-write at least once, if not more often. Froude, in one of his essays, reminds his friends that everything he published was written and re-written at least five times! Before the stenographer and the copying press came into use, our fathers used to prepare a first draft, then carefully correct and amend it, and preserve it as their own record, sending a clean copy to their correspondent. Even twenty years ago mining engineers and geologists wrote their reports and descriptions in long hand, correcting as they proceeded and re-arranging their statements with great care, in contrast to the slap-dash ways of a fluent dictation that obviates all manual labor save the signature.

It is fair to state that the technical writers of today are to blame not so much for their failure to write well, as for the fact that they do not try to do better. Insistence on the need of closer attention to details and of a better feeling for the value of careful writing, may induce the younger members of the profession to exercise more care.

SPURIOUS COIN.

The language of mining and metallurgy suffers from the introduction of terms that are provincial, colloquial, or plainly vulgar. The language of the stope has its use —in the stope; the phrases of the mill-foreman are not without their significance—in the mill; linguistic evolution advances in part, at least, by the adoption of words of lowly birth or even of those of illegitimate origin, but, if the exception be granted, there remains scant excuse for the employment of terms that come from the uneducated, seeing that we have the choice of synonyms that are the gift of scholars. When a college graduate prefers the colloquialisms of a working miner to the terminology current among scientific men, he is recreant to his training. To some among us the crudities of speech heard in mine and mill savor of the practical, and the exactness of the lecture room is suggestive of the theorist who does not soil his hands with labor or his clothes with grease. This is a pathetic fallacy. Yet it has its counterpart in journalism. Just as the mining engineer allows his speech to be modified by the talk of the laborers he employs, so the journalist is apt to allow his writing to be edited as to spelling, punctuation, and other supposedly minor matters, by the compositor who puts his writing into type. Until lately—and in places even now—the editing has been done chiefly by the compositors, not the editors, the latter performing all the sundry duties of their office except the one from which they derive their name. Once in a while a real editor, like Raymond, gives powers of rare quality to the improvement of technical writing, but necessarily the benefit of his service is felt immediately

only by those he is called upon to discipline, namely, the contributors to the transactions of the engineering society of which he has been secretary-editor so long and so successfully. For the rest, it is chaos.

The result is seen in the mongrel words that have invaded the language used by English-speaking engineers, geologists, and metallurgists. Take, for example, such words as **reef, paddock, ledge, sulphurets, gallows frame, leaser,** and so forth. Each of these ought to be tabooed. **Reef** is Australian, it has been adopted in South Africa, and is now used by Englishmen everywhere. It is not needed, it means nothing that 'lode' or 'vein' does not signify, and if it conveys more it is misleading. The sailors and shepherds who started gold mining in Australia thought they saw a resemblance between the outcrops of quartz veins and the coral reefs or other ridges of rock that make navigation dangerous. Much the same notion is involved in the Californian use of **ledge,** although we have learnt long ago that veins of ore do not necessarily jut out at surface or protrude above the desert like the comb of a game cock.

Neither **ledge** nor **reef** is wanted; they ought to be kicked down the back-stairs of language by which they made a surreptitious entrance. **Paddock** is another Australian bastard; it means an enclosure for exercising horses, and the Australians, being keen horsemen, took to using the word in mining. Thus when ore is, or ought to be, 'in the bins,' or 'stored,' or 'stacked at surface,' it is said to be 'in the paddock.' **Sulphurets** belongs to the Pacific Coast and is still employed by persons who ought to know better. It signifies the concentrated pyrite, such as is separated on a vanner. Originally it referred to the sooty

oxy-sulphates found at the bottom of the zone of oxidation. In this sense it was used by some scientific men, but it has lost all such special meaning and is now only a provincialism of the least desirable kind.

Gallows frame is usually pronounced, and sometimes written, **gallas frame**, as if to obscure its unpleasant suggestiveness. Certainly it gives no hint of the lofty engineering structure that stands over the deep shaft of a metal mine. To speak of a towering network of latticed steel as a **gallows frame** is plainly absurd, yet that is done at Butte and Cripple Creek.* Nor is it necessary; we have **head-frame**, even if we do not want the British **poppet heads**. **Leaser** is another Western colloquialism; it is employed in place of **lessee**, but as a matter of fact it is a variation from **lessor**. Thus we see how language is turned inside out, for **leaser** is employed to designate the man taking a lease from the owner of a mine, while as a matter of fact **leaser** means (see any dictionary) the man that grants the lease; that is, it is self-contradictory.

One more bungling term may be instanced, namely, **rock**, which is used among the copper mines of Lake Superior to designate **ore**. Not only do the Finns, the Hungarians, the Swedes, and the other folk ignorant of the English language, employ this term, but the graduates from Columbia, Harvard, and Yale accept the sloppy usage. **Ore** and **rock** all over the world—except in Michigan—are set in opposition as signifying, respectively, the profitable and the unprofitable product of a mine.

These localisms may seem harmless enough, but they are not; they restrict the usefulness of technical litera-

*Incidentally it may be mentioned that **derrick** is derived from Derrick, the hangman.

ture. The American does not know the meaning of **paddock** or **reef**, or reads into them a significance that they do not possess; the miner or engineer in Australia and South Africa misinterprets **gallows frame**, **ledge**, and **sulphurets**. The educated man anywhere is misled by the employment of **leaser** and **rock**. Scores of similar examples are available, but they need not be recited; they are wearisome in themselves and in the iteration of them. There is a broader reason for objecting to all such provincialisms and insularities. The English language is the common heritage of the people of not one mining district, nor one region, nor one country, nor one continent; it is the heritage of the race to which Englishmen, Americans, Canadians, Australians, and Afrikanders all belong, and also of the various races that they have assimilated in the course of their effort to conquer nature the world over. The mere fact that a word is distinctively Western Australian or Californian, is peculiar to Michigan or New Zealand, is reason enough for rejecting it. Let us have a mintage that will pass current at full value throughout the English-speaking world; let it be the refined gold of human speech.

ABBREVIATIONS.

Since an abbreviation lacks dignity, it should not be used at the close of a paragraph and it ought to be avoided even at the end of a sentence. A paragraph embodying a reasoned statement should close with a word that is significant. In oratory, and even in lesser forms of speech, it is natural to end a statement with a word of some consequence. You do not "hit the nail on the head" with a cucumber, and you cannot expect to make a statement incisive with a final word that is of no value in the expression of your idea. It is this feeling of appropriateness that causes the speaker to close an oration with a sentence, and the sentence with a word, that is deeply significant. Literature is speech transferred to paper. Similar considerations govern the employment of language in either case.

The plural is not given to an abbreviation, because it is not a word but a symbol. In some instances the symbol used as an abbreviation refers to an entirely different word. Thus the term **pound** is represented by **lb.**, which stands for the Latin *libra*, and the plural of libra would be *librae*, not libras, therefore *lbs.* is entirely incorrect. **Oz.** is obviously not a direct abbreviation for **ounce** but the apothecary's symbol of that measure, therefore the plural is as improper as it would be if given to a chemical symbol, which is usually not a part of the common name of the element it represents. Thus **Au** and **Ag** are not abbreviations of 'gold' and 'silver' but symbols made from letters occurring in the Latin equivalents.

In the metric system we have to note that **cubic centimetre** consists of two words, therefore the chemist's ab-

breviation **c.c.** should be written with a period after each letter. Some of the chemical societies authorize the use of the form **cc.** but for this there is no excuse save laziness; if the first period is omitted for convenience, the second might as well be dropped and chemists who do not care to bother about niceties should use **cc** as the symbol of their literary independence. Colloquially most of us speak of a **kilo** of silver and when we are in a country using the metric system we talk about **kilos.** The last is a vulgarism; as for the singular form, that is apt in printed matter to be confused with kilometre. **Kilo** is an unscholarly abbreviation; it is better to use **kg.** for the **kilogram** and **km.** for the **kilometre.**

In regard to the dollar as used in Spanish-American countries, especially Mexico, most mining engineers and travelers know what confusion is created by using the same term for two different currencies, for a Mexican dollar happens now, but not always, to be worth about one-half of the American dollar, as measured in gold. It will be well to use the **peso** and **centavo,** instead of the **dollar** and **cent,** when referring to Mexican currency. The **centavo** is abbreviated to **cv.** and the **peso** is represented by the letter P with two bars, like those of the dollar sign; thus: ₱. This is used in the Philippine Islands.

The half-spelling of the thermometrical signs (Fahr., Cent., Reau.) is ugly and unnecessary, as no two of them begin with the same letter. The initial serves the purpose, with the addition of a period.

Many writers appear to have a confused idea that H_2O and Aq. are equal and interchangeable. The first is the symbol of a chemical entity, the second is the apothe-

cary's sign for water as a fluid; one indicates a molecule, the other water as a sensible mass or bulk.

The use of the upper accents to indicate **feet** and **inches** is objectionable, for it is also employed to indicate minutes and seconds; in practice the use of these signs is apt to cause errors, for the omission of one of the accents converts inches into feet. Even in giving a measurement of time it is better to use the verbal abbreviation of **minute** and **second.** Thus: 25 min. 17 sec., unless preceded by degrees, in which case confusion is unlikely and uniformity requires us to write 35° 25′ 17″.

In giving measurements it is better to indicate the multiplication by the word 'by' than by the sign ×, because the first represents the wording as read and the latter, if carelessly written, is easily mistaken for the **plus** sign.

Per cent has ceased to be an abbreviation, for we no longer say **per centum.** It does not need a period.

Thus we arrive at the following rules:

1. Never end a paragraph with an abbreviation. Spell the last word.

2. Abbreviations are used in the singular only. Thus: 17 lb., not 17 lbs.; 15 oz., not 15 ozs.; 11 in., not 11 ins.

3. A period is required after an abbreviation. Thus: The Zinc Corporation Ltd.; the Mysore Gold Mining Co.; 40 ft. long; 11 in. wide.

4. Chemical symbols are not abbreviations, but signs. They do not require a period. Thus:

$$2NaCl+H_2SO_4=2HCl+Na_2SO_4.$$

5. Weights and measures are abbreviated only when preceded by a number. Thus: 20 lb.; several pounds: five pounds.

6. The following abbreviations are noteworthy:

Barrel	bbl.	Gallon	gal.
Bushel	bu.	Horse-power	hp.
Fathom	fm.	Yard	yd.

Miles, tons, amperes, and volts are not abbreviated.

7. In metric measurements the recognized abbreviations are:

Metre	m.	Gram	gm.
Kilometre	km.	Kilogram	kg.
Centimetre	cm.	Milligram	mg.
Millimetre	mm.	Cubic centimetre	c.c.

The metric **gram** and the English **grain** must be spelled whenever there is a chance of confusion; otherwise use **gm.** for **gram** and **gr.** for **grain.**

8. In referring to money, the dollar sign should not be used for Mexican currency, but that of the peso, thus, ₱. The following abbreviations are correct:

Cent	c.	Florin	fl.
Centavo	cv.	Penny	d.
Franc	fr.	Shilling	s.

In the case of foreign money, it is usually best to spell words designating currency, if there is any chance of a misunderstanding.

9. In abbreviating the thermometrical and chemical scales, use the following:

Centigrade	C.	Réaumur	R.
Fahrenheit	F.	Beaumé	B.

10. The words **figure** and **number** are abbreviated when preceding a numeral. Thus: "There is a diagram of No. 2 shaft in Fig. 3."

11. The word **company** is abbreviated when part of an official name. Thus: The Camp Bird Mines Co. When used informally it must be spelled, as: "We understand that the Camp Bird company is to build a new mill." The **and** forming part of the name of a company is written with the ampersand. Thus: The Butte & Boston Copper Mining Co.; the Denver & Rio Grande Railroad.

12. Use abbreviations, not signs, to indicate feet and inches or minutes and seconds. Thus: 14 ft. 3 in., not 14′ 3″. Also 34 min. 5 sec., not 34′ 5″, unless preceded by degrees; then 10° 34′ 5″.

13. Use the word 'by' instead of the sign × in giving dimensions. Thus 8 by 12 in., not 8×12 inches. Also: 12 divided by 3, making 4 ft., not $12 \div 3 = 4$ ft., except in mathematical tables or treatises.

NUMBERS.

In making rules for the use of numbers it is necessary to recognize the exceptions. The styles of different printers exhibit an amusing diversity and the attempt to observe any cast-iron rule will lead to trouble.

While it is usual to spell numbers less than 10, because they are represented by short words, it is desirable to use figures even for numbers less than 10 when they are grouped with other numbers of 10 and over. Thus: "The length in one case was 2 ft., and in the other it was 11 ft." This puts the two figures in better contrast than by saying: "The length in one case was two feet, and in the the other it was 11 ft." Similarly, when weights or measurements are being compared. Thus: "The timbers used were 2 by 4 by 12 inches" or "one vat was 8 ft. deep and 6 ft. diam., while the other was 10 ft. deep and 8 ft. diameter." The figures emphasize the idea of relation of size better than if the dimensions were expressed in words.

Figures indicate some attempt to be accurate, so that when a mere approximation is intended it is well to avoid the use of them. Thus: "He lived here twenty years ago," if it was about twenty years ago; but if it was exactly 20 years, then employ the figures.

Three shades of accuracy are expressed by ten, 10, and 10.0. Ten is approximate, 10 is accurate, 10.0 is exact. The last form is used only in connection with other decimals. For example: "One streak of ore is 8.4 in. wide, another is 9.3 in., and a third 10.0"; meaning thereby that the possibility of a slight excess or deduction from 10 has been considered, and rejected, the measurement being absolute.

The use of unnecessary ciphers is apt to cause an error by misplacing the decimal point. Thus $5.00 may be made $500 by the dropping of the point. It is obvious that $5.00 offers no advantage over $5; it is calculated to mislead, for the extra ciphers make it loom larger than the single figure. People who offer rewards for missing poodles do well to state that they are prepared to pay $1.00 for the lost dog, for $1.00 looks like more money than $1, which seems little enough for a valuable puppy.

In regard to the use of the comma, it is customary to employ it for the thousands, but this is not necessary and it divides the figures unpleasantly; therefore, it is well to write 5000 and 2500 rather than 5,000 and 2,500, using the comma at the next stage. Thus: 5000, not 5,000; but 51,250, not 51250.

As to decimals, it is fair to say that technical men should employ them whenever they mean to be exact and whenever they have the information permitting of such exactness, reserving the employment of fractions for approximate statements. Thus: "The ore carries 2.25 (not 2¼) oz. gold and 10.75 (not 10¾) oz. silver per ton," if an assay has proved this to be the case. It is best to say, "The distance is 2½ miles" when all you know is that it is more than 2, and less than 3, miles. If the distance has been measured and it is known to be exactly 2.5 miles, the decimal is preferable. Do not make a pretense of accuracy by using decimals when they are not wanted.

Hours or minutes less than 10 should be spelled (two hours) unless grouped with figures of 10 and over (12 hr.) or with a decimal (as 1.5 hr). 'One and five-tenths

hours' is preferably not spelled because it spreads too much and is clumsy.

There is another exception: I refer to dimensions such as eighth, sixteenth, or thirty-second, which are used in mechanical engineering, where tools and appliances are made in fractions of an inch. To say 0.125 in. or 0.03125 in. will not convey what is meant, because the fractions refer to standard sizes quoted in the trade, and not actual measurements. A quarter-inch plate is not necessarily exactly 0.25 in. thick.

The foregoing ideas are embodied in the following rules:

1. Use figures for 10 and for numbers over 10. Spell those under 10.

The following exceptions must be noted:

(a) When beginning a sentence, as: "Fourteen men working six days completed the dam."

(b) When there are several references to numbers, so that the figures accentuate the statement of fact. "Nine men working 6 days with machine-drills were able to sink the shaft 9 ft., breaking 75 tons of ore."

(c) When one number follows another, spell one of them, preferably the smaller: "He took samples at 50 five-foot intervals." "The manager bought eleven 24-ft. belts."

(d) When an approximation is intended. Thus: "This was a lively mining camp twenty years ago." "He will be a rich man ten years hence."

2. Omit unnecessary ciphers in stating sums of money. Thus: $2, not $2.00; $5000, not $5,000.00.

3. Use the comma for more than four figures, not otherwise. Thus: 5000 and 50,000.

4. Use decimals in place of fractions whenever you mean to be exact, not otherwise.

5. In decimal numbers having no units, a cipher should be placed before the decimal point. Thus: Not .32 lb., but 0.32 pound.

Usage determines the meaning of words. In the end a word gets to mean what people in general intend it to mean. When you violate good use, you employ the word in a sense likely to be misunderstood, and then the word becomes either a blank or a snare. The Western American who speaks of doing the work of a 'mucker' in a mine is unintelligible to the Australian, and the New Zealander who talks of putting ore in a 'paddock' is offering not information, but a riddle, to the Canadian. The use of spurious words or the colloquial jargon of the illiterate tends to take us back to the monkey stage, for man's chief distinction from the lower animals is his gift of intelligent speech.

THE MATTER OF EDUCATION.

Technical men, such as engineers and geologists, are not always graduates from a university nor, even if they happen to have received a liberal education, are they necessarily well trained in the use of the English language—that is, the training founded upon lessons in the languages of antiquity, followed by familiarity with the classics of their own tongue. Undoubtedly such a preparation is useful, but the value of it can be over-estimated. Not long ago a mining engineer, who occasionally contributes to technical journals, took pains to explain to me that he was not a college man, as if to excuse the lack of finish in his writing. It seems worth while to dwell on this point, in order to encourage those who have both knowledge and ability to write intelligently, without the aid of previous teaching either in Greek and Latin or in Milton and Meredith. To be taught a language systematically is like any other form of mental training, it is a short-cut to efficiency, enabling the student to acquire, rapidly and thoroughly, such skill as would otherwise be attained only laboriously and imperfectly. Nevertheless, there are those that have taught themselves, by practice and association, whether of men or books, to write well the language of foreign lands or of their own; on the other hand, there are many owners of a university diploma that have so skillfully evaded instruction in the proper use of their own language, not to mention a foreign tongue, that they are, to all intents and purposes, illiterate. The modest fellow who excused himself to me, on the occasion above mentioned, had learned to write in a straight-forward unpretentious way, which in itself con-

stituted the style best adapted to technology. He might lack the classical learning required of a man competent to undertake the preparation of a 'Synthetic Philosophy' or 'The Decline and Fall of the Roman Empire,' or an 'Essay on Criticism,' but for the purpose in hand, namely, to describe an ore deposit or discuss a problem in metallurgy, he was adequately equipped. Rhetorical confectionery and frills of any kind are out of place in technical writing, except on rare occasions. The sort of self-consciousness that leads to verbal gymnastics is in itself bad form and it is affected only by the half-educated. There is the simplicity of diction marking the man acquainted with several languages and the master of at least one of them; and there is the simplicity of unpretentious speech belonging to the man who has but a working knowledge of his own language, and makes the most of the instrument at his command. Between them comes the writer who ought to know better, but, from conceit or ignorance, deems it a waste of energy to use his verbal weapons so that they shape his thoughts into carven words, whether vitalized in the speech of the moment or sculptured in the writing that lives.

Two examples, founded on fact, will illustrate my argument. I had the pleasure of editing a long and detailed article describing the operations of a certain metallurgical process; there was no room for a literary pose, the whole account was eminently practical and businesslike. This article was so well written as to require scarcely any editing, and when it was published I referred gratefully to the excellence of the writing. Happening to discuss the incident with a friend, who knew the writer of the article personally—as I did not—this common friend asked me

to guess for what occupation the writer had been trained, and I answered: "The ministry." This happened to be exactly right, for he had been to Oxford and was intended for the Church before he wandered into a cyanide mill. All the marks were there, such as a quiet command of English and a masterful use of it, making a difficult bit of technical exposition as clear and interesting as the subject permitted. And since "the home of lost causes" is not my alma mater, I am glad to acknowledge the value of Oxonian English in the literature of science. More of it would be a great relief to the readers—not to mention the hard-working editors—of technical periodicals.

My other example is less different than, at first sight, it may appear. I have in mind an article describing mining conditions in a Central American republic. Such descriptions are usually made as verbally florid as the vegetation of the tropics and they are frequently as involved as the jungle itself; at the best, it is customary to bespatter them with unnecessary Spanish words and to deal in gorgeous generalities supposed to indicate the unlimited mineral resources of an inaccessible region. From all these common faults, this article was free. The sentences were short and to the point. The statements conveyed information and yet avoided exaggeration. The writer kept what he knew at first hand separate from what he had merely been told; he gave just the data the average intelligent reader would be likely to want, and a touch of humor was not lacking in a reference to the queer things that happen on the Spanish-American frontier. It was like the sensible talk of an intelligent traveler who had kept his eyes open and his notebook handy. The writer had received no special training in his own lan-

guage, nor in that of another; as the graduate of a technical college he had been given rather more of contempt than love for the use of proper words in proper places, and yet, by native intelligence and the desire to do his task well—his task being to tell what he knew of mining in this particular region—he had succeeded in preparing a contribution that was in its way as good as that of the Oxford man. Both men were unaffected, both kept in mind the purpose of the writing, and both knew what they were talking about. The moral of it all is that bad writing is due either to insincerity, or carelessness, or ignorance.

HYPHENS.

Hyphens may be considered ungainly, but they are necessities in technical writing, where materials and machinery are continually being described under conditions modifying each other. There is a varying degree of intimacy between adjacent words. This is expressed in three ways:

1. Mere juxtaposition of separate words, indicating a loose connection.
2. Hyphenation, implying intimacy without entire loss of individuality.
3. Compounds, expressing a singleness of meaning.

Thus: An 'ore deposit' is a deposit of ore, and you can drive a cross-cut to find either the **deposit** or the **ore**. Moreover, a **deposit** is not necessarily composed of ore; it may consist of mud or guano. Likewise the **ore** may not be in the form of a deposit; it may be in a mill-bin, or in a furnace. In the case of an 'ore-shoot' there is a duality, but not a separateness, of meaning, and while the **shoot** may be mentioned by itself the idea of **ore** is assumed, this intimacy being recognized by hyphenation. Finally, in 'orebody,' we have a true compound, for the miner does not drive his drift to discover some indeterminate kind of **body**, nor does he say that the **body** is large or rich; he speaks of **orebody** as signifying one idea, the separate portions of which, the body (substance) and the ore (attributive), are completely merged in the notion of a mass of valuable rock, constituting an orebody. Another example may be given, thus:

A **blackbird cage** is a cage for the songster known as the blackbird.

A **black-bird cage** is a cage for birds that are black.

A **black bird-cage** is a black cage for birds.

A **black bird cage** might mean a black cage for birds, or a cage for black birds, or a cage for blackbirds. Unless two of the three words are hyphenated or compounded, the meaning remains unknown. Further examples referring to technical subjects will make clear the service done by hyphens.

A **single-stamp mill** is one possessing batteries of one stamp apiece, like the Nissen stamp, instead of the usual five.

A **single stamp-mill** is a lonely mill, like some to be seen in the deserts of Nevada.

A **single-stamp-mill** possesses only one stamp, after the Lake Superior fashion, where one big steam-stamp does the work of 150 ordinary gravity stamps.

A **crude ore-bin** is an ore-bin of crude construction; a **crude-ore bin** is one made to contain crude ore, that is, ore as it comes from the mine, before concentration in the mill; a **crude ore bin** is an example of crude writing.

In the manufacture of nitro-glycerine the charge is 'drowned' in a large volume of cold water; the receptacle in which this is done is termed the 'drowning-tank.' Should the hyphen be omitted, it might be supposed that the tank was drowning and sympathy would be needlessly excited. Similar examples are **cooling-floor, roasting-hearth, grinding-plate, settling-vat, amalgamating-pan,** and so forth.

The first part of these compound words is a gerund; that is, it is a verbal noun identical in form with the participle; the participle is an adjective, but the gerund is a noun that has the power to govern another noun. For

example: A **cooling floor** is one that, having been hot, is becoming cold. Here **cooling** is a participle serving as an adjective. A **cooling-floor** is a floor upon which hot ore is placed for the purpose of cooling; in other words, it is a floor employed for cooling ore. Here **cooling** is a gerund, doing duty as a noun.

Hyphenation is necessary to prevent ambiguity. Thus a **settling-vat** is a vat in which particles of ore are likely to settle, but a **settling vat** is one that is subsiding, for example, by reason of a landslip or bad foundation. A **zinc box** is made of zinc, but a **zinc-box** contains zinc; for example, the compartments in which zinc is placed in order to precipitate gold from cyanide solutions. These boxes are **precipitating-boxes**, not **precipitating boxes**, because they do not precipitate the gold, they merely afford the facilities for the precipitation. A slag-pot receives slag; it is not made of slag, as is a slag pile.

The following quotation vividly illustrates the value of the hyphen: "**Iron screens** in **zinc boxes** are detrimental in as much as they facilitate solution of zinc." The screens are made of iron and they are placed in wooden boxes, into which zinc shaving also is introduced; the boxes are not made of zinc, although the sentence says so. It ought to read: "Iron screens in zinc-boxes are detrimental because they facilitate the solution of zinc."

A **roasting-furnace** is one in which ore is roasted. The furnace does not do the roasting, but the fuel that is in it. A **roasting furnace** is one that is being consumed by excessive heat, as in a conflagration. A **grinding plate** is one that grinds, but usually it is a **grinding-plate**, that is, a piece of steel or iron by the medium of which the ore is ground against another hard surface. It is a plate **for**

grinding. Likewise an **amalgamating-pan** is one in which the process of amalgamation or combination with mercury is effected; it is not the pan that does the work; it only provides the receptacle in which the action takes place. If it were the active agent, as sometimes the iron is actually supposed to be in the chemistry of the process, then indeed it would be correct to call it an **amalgamating pan,** without hyphenation. Familiar examples are carving-knife, walking-stick, and chewing-gum.

"Brown agitating tank." This might suggest that a **tank** that was **brown** in color was being **agitated.** Each word needs amendment. On reading the context, the reader could ascertain that it was not a **tank** but a **vat,** for cyanidation; it was a **vat** in which the solution was **agitated;** it was the invention of **Brown.** Therefore, the title should be Brown's agitating-vat (that is, vat for agitating) or agitator-vat.

Between true nouns the hyphen may be needed to mark intimacy between words. Thus: "The gases are taken into steel dust-chambers where a large proportion of the flue dust is settled." A hyphen is needed after the first **dust,** otherwise it may be chambers containing steel-dust, and not dust-chambers made of steel, as is meant. **Flue dust** also requires hyphenation; the dust does not consist of flues.

A **wet-milling plant** is one in which a wet process is employed, while a **wet milling-plant** is a mill in which water is wasted; it is a sloppy establishment.

In some cases the hyphen is needed to prevent confusion or to give emphasis to the meaning of the prefix **re** as in:

Re-treat (to treat over again), which might be mistaken for **retreat** (to retire).

Reconstruct is equivalent to rebuild but **re-construct** goes a little further, as if to say that it is being built all over again. Before a word beginning with a vowel a hyphen is especially desirable, as in re-ignite, re-imburse, re-incorporate. The prefix **re** is given with varying emphasis, as in **relegate** and **re-locate**; in the latter the idea of repetition of the act of locating is strong, therefore we write re-locate and not relocate. In **co-operate** and **co-ordinate** the hyphen takes the place of a dieresis.

Between numbers expressing a range of measure or quantity, it is well to avoid using a hyphen. Thus: "The addition of 5-7 c.c. of preventive solution" is improved by writing "5 to 7 c.c.," for a dash in the manuscript might be taken for a period; in reading we say "to," therefore it is well to write it.

The **fifty-first** means the one coming after fifty, but the **fifty first** are the fifty that come first, or the first fifty.

The hyphen is not needed between adjectives, as **light blue, yellowish green,** where the first plays the part of an adverb. In **blue-black** it seems unavoidable.

Between an adverb and a participle (even in an adjectival form) the hyphen is not required, thus: well defined, finely developed.

Two nouns should be hyphenated if they are brought together to name one thing and neither of them is used distinctively in the adjectival sense. Such compounds are elliptical condensations of a phrase, and the normal sequence of the words is inverted. Thus we have **freight-train** (train for freight), **foot-note** (note at the foot), **field-work** (work in the field).

Two words grouped in an attributive position seem to be welded together, but when they are in the predicate they appear to have an independent meaning. The attributive group is hyphenated, while the predicate is not; in the predicate the adverb is stronger, thus:

1. "I followed the half-obliterated footsteps."
2. "The footsteps were half obliterated."

Of course, hyphenation can be carried too far, and it has been abused even by good writers for the reason, among others, that they have developed the habit from familiarity with German, a language in which compounding is carried to a distressing extreme. Thus we read:

1. "The supply of lead-ore at any particular plant."
2. "These magnetite-deposits are associated with gneisses."
3. "The nickel in an iron-ore would be of value."
4. "Decrease in the residual sulphur-values, indicating a greater sulphur-removal."
5. "The use of mining-machinery during a period of five years."
6. "Comparatively few bituminous coal-mines can be equipped."
7. "The several makes to-day differ only in details."
8. "Under every-day working-conditions."

These examples are taken from a few pages of Vol. XXIX, of the Transactions of the American Institute of Mining Engineers. In most instances the hyphens are not needed, for they do not make the meaning clearer; they are not regrettable necessities, but avoidable disfigurements. In several cases the use of them can be set aside advantagously, for "these deposits of magnetite" is pref-

erable to "these magnetite deposits." In the fourth example, the hyphen is awkward. In the fifth it seems wholly unnecessary. In the sixth, it is not the **mines** but the **coal** that is **bituminous,** therefore it ought to be **bituminous-coal mines. To-day** does not need a hyphen; it is a compound so familiar as to have attained the meaning of a single word. In the last example we have a Germanized construction that is expressive but awkward; there is nothing gained and something lost by the use of the hyphens. Why not write: "Under everyday conditions of work." It is well to make technical writing as attractive as the subject will permit.

Hyphenation represents an early stage of union. After a while, by use, the association of ideas becomes fixed, so that the pair of words is wedded, forming a literary unit. The chief reason for hyphenation of two words is that when so connected they have a meaning slightly different from that which they convey when given separately. But it will not do to lean too heavily on the hyphen; illustrations of distinctions can be given, as above, but in practice it is well to avoid all risk of confusion. In speaking there is a variation of pronunciation between the members of a hyphenated couple, affording a subtle distinction not transferable to written language. **In writing, the desire to be lucid should be the controlling factor.**

SOME WORDS AND THEIR WAYS.

The description of metallurgical processes and the explanation of technical methods, whether in mine or mill, will be rendered clearer, and therefore more useful, by the selection of the right words.

Vat and **tank** are used as synonyms, **tank** having come into general use in connection with cyanide work. This is unfortunate. A **tank** is a large vessel or receptacle, made either of wood or of metal, intended to contain a fluid, such as gas or water. 'Water tank' and 'gasoline tank' represent correct usage. The transfer of the word to chemistry is not warranted. For that purpose we have **vat**, that is, a vessel or tub in which ore is washed or subjected to chemical treatment. 'Cyanide vat' and 'chlorination vat' are correct. Because illiterate and non-technical people use technical terms wrongly, engineers are not justified in adopting sloppy ways of speech.

Ledge, reef, and **lead** afford examples of the same kind. **Ledge** and **reef** are localisms, originating in California and Australia, based on early geological misconceptions of the nature of a 'lode' or 'vein.' **Ledge** refers to the prominence of the outcrop and **reef** to the projecting edge, resembling the rocks that endanger navigation. There is no need of these terms now. In so far as they have a special significance, it is misleading. As to **lead,** it is a good old term, for it is allied to 'lode' and indicates the meaning of the latter, as something that leads the miner in his exploration, but the term is now applied exclusively to gravel deposits, as in 'deep lead,' which is an alluvial channel blanketed by lava. **Lead** should not be used as a synonym for 'vein' or 'lode.'

Sulphuret is rarely used nowadays save on the Pacific Coast. It is a term that some people who ought to know better use in place of 'sulphide.' **Sulphuret** was used at one time to designate the earthy sulphates formed in the early stages of oxidation of sulphides, but this distinction is no longer observed and the term is now a mere localism, without special meaning. 'Concentrate' and 'sulphide' are preferable.

The use of the term **country rock** amounts to tautology, as was pointed out by Le Neve Foster many years ago. If we could agree to use **country** by itself, it would be well. Obviously it must be **rock**, although we read sometime ago in a Colorado paper of a drift that was "in no formation," meaning thereby that it was in rock of no definite structure. The workings of a mine cannot penetrate anything but rock, unless it be a snow-drift, as happened once in the case of some crafty contractors, who closely timbered 50 ft. of an adit that went through a snowslide before it became a bore in a granite mountain.

Vein-stone is a similar survival from the days when mining literature was written for people that were not supposed to know anything about such matters. And thus we come to Australian usage, which is derived from untechnical sources. At Bendigo and Ballarat they talk of "good-looking **stone**," meaning 'ore'; of "a make of **stone**," meaning an 'ore-shoot'; they strike "rich gold" in a shaft and find "poor gold" in a cross-cut, meaning quartz rich or poor in gold. These terms appear even in Australian mine reports that are prepared by educated men, who simply get their terminology from illiterate workmen.

Fully as bad is the usage obtaining in the Lake Supe-

rior copper mines, where they exploit **copper rock** and obtain **mineral.** For the use of **rock** instead of 'ore' there is no excuse whatever; for **mineral,** meaning the native copper extracted by milling, there is some reason, for is it not **the** mineral in that region? It is a localism that has become rooted by repetition. But no self-respecting engineer ought to use **rock** in the Keweenaw way.

Then there is **mineralization,** to which some object. It comes to us from the French, who will say that an ore is *bien mineralisé,* just as we (with an apology) may say that it is 'well mineralized.' *Minerai* is French for 'ore' and *mineralisé* is employed as the corresponding adjective, despite its derivation from *mineral.* When we use 'mineralized' and 'mineralization,' we mean that the rock is full of the valuable minerals that constitute, or else accompany, ore, but as we do not hark back to *minerai,* our use of these English terms is not academic. However, in default of better terms, **mineralized** and **mineralization** are acceptable.

In Australia they call a level in a mine a **drive,** and this is the custom among Englishmen generally. In America we say **drift,** and this is correct. A miner **drives** his working ahead and the result is a **drift.** For example, it is correct to say:

1. "Ten feet of driving was accomplished."
2. "The north drift was advanced five feet."
3. "The lessees drove the drift as rapidly as possible."

Similarly, in regard to another form of mine working, you **rise** and the result is a **raise.** It should never be **upraise,** as sometimes appears in reports on mines. **Downwinze** would be no worse.

It is unfortunate that in so good a book as Le Neve Foster's 'Textbook of Stone and Ore Mining' he should have given **chute** as the American equivalent of '**ore-shoot**'—which it is not. The employment of **chute** instead of **shoot** to describe an orebody of definite shape and pitch is now an English error, for it is rare in America. An error it is. **Chute** is a mode of spelling 'shute,' which is an inclined trough for conveying materials. Thus:

"The ore broken from the new ore-shoot passes down the chute that leads to the mill."

The distinction, now fairly well established, between these two terms is worthy of general adoption among English-speaking technical men.

Tunnel is commonly employed to designate a drift or level penetrating a hillside; this is wrong, for a 'tunnel' is a gallery or bore that goes **through** a mountain from daylight to daylight, as a railroad 'tunnel' does. The long cross-cut or drift that enters from the surface, becoming the main artery of the mine, serving both as an exit and to drain the workings, may best be labeled an **adit,** which is a good old technical word long known to miners. On the other hand, the short drifts or levels that are run by prospectors into the hillsides of our mining regions, and which cannot well be called by so big a name as **adit,** need not be called **tunnels,** seeing that 'prospecting drift' or 'exploratory level' or plain **drift** or **level** will serve for the purpose. The French have *galerie* and we sometimes use the English equivalent, but it has become archaic.

When words have a prescribed duty to perform in technology, it is well to limit their use to a particular meaning. Thus **locate** and **location** are employed in min-

ing to signify, respectively, the act of delimiting a claim and the claim when thus delimited. It is a common error to use **locate** instead of **place, situate, reside, find,** etc., as in the following examples:

1. "The company located the mill on the side of Gold hill."

2. "The town is located on Alder creek."

3. "He was located at Tonopah."

4. "The superintendent located the ore-shoot at the fourth level."

5. "Where the office, quarters for men, and ore-bins are to be located.

In the first it would be right to say that the millsite was **located** at a certain place, but the building itself was **built,** or erected there. The second case is common; the town is **situated,** although the townsite might be **located,** on the creek. The third is an ugly colloquialism. It should be: "He **resided** at Tonopah," or plainly, "he **lived**" there. In the fourth, the writer means that the position of the ore-shoot was ascertained, or briefly, that "the superintendent **found** the ore-shoot." In the fifth, **built** will state the meaning.

6. "Ore has been found on four new locations on the property." He does not mean what he says, for he states that ore has been found on four new claims (that have been located, but not patented). He means four new places or spots or points.

7. In one of the Geological Survey reports it is written: "In planning the position of stopes the assay charts often enable the location of pillars in relatively poor material." This should read: "In platting the stopes the

assay-charts often indicate the best position for pillars in the relatively poor lode-matter.

The last abomination in the way of making **locate** do improper service is that which I saw lately in a newspaper heading; it appears that a man had found his missing wife, and the fact was announced thus: "Locates his wife in Napa."

A test for the use of words is furnished by translating such sentences into a foreign language, when it will be noted that the translator will disregard the colloquialisms, finding it necessary to adopt the equivalents of the words that ought to have been employed.

Section is another word that, despite a specific meaning, is employed for sundry purposes. One would not use a pair of compasses as a fork nor a scalpel to cut bread. Precision of speech is required to express scientific ideas, and we lose such precision by making technical words do the chores of literary work. Here are some examples:

1. "The richest section of this mining district."

2. "They have as good a property as there is in that section of the camp."

3. "In the southern section of the State, they grow oranges."

In all of these, **part** or **portion** is meant. **Section** means the view of something along an intersecting plane, as used in geology or drawing. As the subdivision of a township, another meaning has been established. These are enough; for other purposes we have other words. Even the American Association for the Advancement of Science might have spared the word from doing duty to designate the divisions into which the Association is separated for the discussion of different subjects, so that there is a 'Section

of Geology,' another of Astronomy, and so forth. But it is too much to expect scientific men to make a study of the use of language; in that, they continue to be far behind people of lower intelligence.

The words **dip, hade,** and **pitch** are used confusedly. It will be well to apply **dip** to the inclination (from the horizontal) of strata, veins, and faults, rejecting **hade** as a term no longer necessary and only likely to make confusion, because it refers to the angle from the vertical. The angle made by an ore-shoot in the plane of the vein is its **pitch**; this also should be measured from the horizontal. Thus:

1. "The pitch of the apex of the saddles at Bendigo ranges from 10 to 30°, either north or south."

2. The main orebody had a pitch of 80° southeast."

The word **slimer** is used by several manufacturers of machinery to describe a device for treating slime, by concentration of the valuable minerals in it. A **slimer** is a machine that **makes** slime; such is a tube-mill. A **slime-table** is one that **treats** this mill-product.

"John Smith is manager of the Great Bullion Co." No, he is manager **for** the company, and manager **of** the mine. Similarly, he may be consulting engineer **to** the neighboring mining company.

Use **lessee,** not **leaser**; the latter is a mere vulgarism and apt to be confused with the **lessor,** who is on the opposite side of the fence. As explained elsewhere, **leaser** is really a variation of **lessor.**

"A partial history of the district indicates that, etc." Meaning a **part** history or an **incomplete** history or a **portion** of the history, but not a prejudiced history, as might well be supposed.

"At times the ore is very rich." Meaning, in **places.**

A curious example of the misuse of technical terms is afforded by Gilpin county, Colorado, where it has become the local habit to speak of the concentrate saved on shaking tables as 'tailings.' It is literally a contradiction in terms.

Value.—The misuse of this word, and its plural, is a good example of a colloquialism, harmless enough in a stope or in a mill, but a solecism in literature. It is also an instance of the employment of the abstract for the **concrete,** one of the primary blunders in poor writing. "This mill is intended to extract the values in the ore" is a vague way of saying that it is meant to extract the gold or lead or silver or the **valuable metals** in the ore. **Value** is the desirability or worth of a thing; it is an attribute, not a substance. A man that designs a concentrator to "catch the values," might as well build a railroad to pursue a quadratic equation. Nevertheless, this vulgarism of the mining camp has crept into technical literature, and it can be found in articles otherwise well edited. Here are some examples:

1. "In sinking the values were lost." Meaning that the ore became poor, or that the **valuable ore** ended.

2. "The vanner saved all the values in the ore." Meaning, the **valuable minerals** that the ore contained, or all that was valuable in it.

3. "And then the gold values are precipitated on zinc shavings." No, it is the **metallic gold** that is precipitated; you can precipitate a panic by reckless banking, but you dont precipitate anything so vague as **values** on something so tangible as zinc shaving.

4. "In this region there are found ore deposits, prin-

cipally with gold and copper values." Meaning, chiefly valuable for gold and copper.

5. "With the development of values in the quartz veins south of the Butte hill, there has been a scramble for claims." It would be better to say, "When it was proved that the quartz veins were valuable, etc."

6. "The mill will be used to test the copper values of the rock from the Nonesuch mine." Meaning, **the value of the ore** as regards copper, or its copper content.

7. . "The gold values being largely free-milling." Here the objectionable word can be dropped entirely. It is the **metal** in its native state that is docile to treatment.

8. "Where cemented ground is handled, ample provision must be made for breaking up the gravel and separating the values." In the first place you do not break gravel **up** or **down**; here 'disintegrate' is meant. You do not separate the **values**, except on an accountant's page; here it is the gold and platinum that were separated from the matrix of gravel.

9. "The Broken Hill ore assays 16% lead, 15% zinc, and 11 oz. silver. Until a few years ago of these values only 65% of the lead and between 45 and 50% of the silver was saved." No values are stated. **Valuable** metals are indicated. By omitting "of these values," the statement will be made clearer.

10. "The ore carries $150 per ton in values." This is clumsy. "The ore assays $150 per ton" conveys all that is meant, for assays are not usually made for metals having no commercial value.

In many cases "the values in an ore" is used to express the profitable portion of it. Thus, someone "extracts the values by the cyanide process." Again, it stands for the

relative richness or grade; thus: "The values fell off soon after the mill was built," meaning that the grade or tenor of the ore declined. The sentence as given is often a pathetic fact as well as sad grammar.

"The values are in the galena," meaning that the gold or silver is closely associated with the galena, that is, to put it plainly, "the gold is with the galena." By dropping this misuse of **value** and **values** we shall clarify technical writing.

Much the same line of criticism can be followed in regard to the use of the term **strike**, as:

"The Cresson property reports a strike of high grade value from which shipments will be made." This is full of colloquialisms. The property does not report anything, this is done by the superintendent or some other man in a position to know. Property is a pretentious synonym for mine. **Strike** is used in mining to indicate a discovery, and it is over-worked, for *The Evening Post* tells of **ore-strikes**, as if the miners might strike an ichthyosaurus; they would then strike for higher wages. It is a pity to make **strike** do double duty, for it tends to confusion. When you hear that there is "a strike at the Bullion mine," you are left in doubt whether the men have abruptly cancelled their agreement to work or whether the miners have broken into a body of rich ore. **Strike** may well be reserved for the first of these meanings; for the other service we have many words and phrases, such as "cut an orebody," "discovered ore," "intersected a vein," "broken into a bonanza," "found rich ore," "penetrated an ore-shoot," and so forth. The use of the verb as in "They struck ore," "He expects to strike oil," is preferable to the employment of the noun, as in "He

made a strike," "There is news of a rich strike." Used thus it is a colloquialism, and while colloquialisms may by usage become legitimatized, it is safe to say that the only reason for employing them is the fact that they do the duty no other words can perform as well. If a colloquialism can be avoided, it should be; and if the colloquial use of a word makes for confusion by reason of other legitimate uses, it is well to forbear. **Strike** is the compass course of a line and is so used in mining geology and surveying; that is its proper technical service. In economics, it signifies the rupture of relations between an employer and his employees. These two usages do not conflict; they suffice; let us not overwork our terms, lest they fail to carry our meaning.

Returning to the quotation: It was a "strike of high grade value," meaning a 'discovery' of rich ore or a 'find' of valuable ore. **High-grade** should be hyphenated. Then it is said that shipments will be made from "the strike of high grade value." This is an arithmetical exercise, for only in mathematics can you transfer high-grade values. The whole sentence, interpreted into plain English, means: "It is reported from the Cresson mine that rich ore has been found and that shipments will be made shortly." Of course, the shipments must be made soon; if not, the reference to shipments is unnecessary; ore once discovered is not supposed to lie in the ground indefinitely. So the statement may well be abbreviated to: "It is reported that rich ore has been found in the Cresson mine."

Orebodies and lodes are often described as **permanent,** meaning thereby **persistent** or **continuous.** For example:

1. "The ore deposit is of a **permanent** character."

2. "The officials of the company feel confident that it is a **permanent** vein."

3. "Gash veins are short-lived, but a true fissure vein is usually **permanent.**"

The only way to make an orebody **permanent** is to leave it in the ground; the whole trend of mining is to destroy the permanence of aggregations of ore, to break them, to remove them, and to treat them so that a part, as bullion, goes to the mint or to the manufacturer, while the remainder disappears into the creek that receives the tailing from the mill or the slag from the smelter.

The lack of a classical education leads many scientific men into vulgar blunders. For instance, in *Science*, the official organ of the cult in America, there appeared recently such statements as that "the underlying strata was a soft limestone," and that "this phenomena was closely observed by us," and that "we owe this data to the courtesy of Mr. ———." No wonder that Professor Hilgard remarks that the restriction of the scientific curriculum to the limited language-study of the high-schools is yielding unfortunate results.

Sainte-Beuve said of Napoleon, and Matthew Arnold of General Grant, that clear-cut thinking is indispensable to the best writing.

UNCONSIDERED TRIFLES.

Very.—This unpretentious little word is worked to death, like the donkeys of a mining camp, which are apt to be hidden under a big load of lumber or other supplies. Nine times out of ten **very** can be omitted without loss, because it serves only to increase the number of words.

Very pre-supposes a comparison. A four-story brick building is **very** large to those who live at Salmon City, Idaho, and it may there do glory to the name of a former senator, but it is as nothing to those who live among the 'skyscrapers' of New York. A mine with a 1000-ft. shaft is **very** deep to the scribe who writes on the *Weekly Howl* in a new camp in southern Nevada, but it is shallow compared with the openings on the Comstock lode. A vein that is ten feet across is **very** wide as seen at Cripple Creek, but it is a thin seam to a man who is working in the Homestake mine. It is all a matter of comparison, and unless your reader knows your standard, the **very** possesses no significance.

When a man says that "the ore of the Great Wildcat Extended mine is **very** rich," it depends upon what his ideas of rich ore happen to be. On the Mother Lode in California 15 dwt. ore is **very** rich; at Goldfield, in Nevada, such stuff is low-grade. If you do not know the writer's notion of richness, his **very** is wasted.

Or again, someone writes: "The district is **very** prosperous, there being many **very** rich mines, some of which are **very** deep and **very** extensive, so that there is a **very** good hope of **very** many years of **very** successful development." It is a debauch of emphasis, and all of it is

wasted unless you know the writer's standard of prosperity, richness, depth, extent, and so forth. Cut out each **very** and the sentence will lose nothing.

There is an air of exaggeration about statements burdened with a frequent **very**; on the contrary, there is a suggestion of moderation and assured knowledge in the descriptions that convey ideas of relation without a repeated lashing of that little word. Out of ten **verys**, nine can be dropped without affecting a statement, save to strengthen it.

Occasionally the effort to emphasize defeats itself, thus:

1. "This machine makes a **very** perfect separation of the mineral from the gangue."

2. "It is **very** obvious that the mine is well worth the price asked."

In both these cases the **very** weakens the force of the statement, instead of reinforcing it, for a **perfect** separation cannot be bettered; it is apparent that if the writer means anything, he means that the separation is *almost* perfect. In the second case, a thing is **obvious** or it is not; it can neither be *more* obvious nor *almost* obvious; from the unnecessary emphasis we are led to suspect that it was *not* wholly obvious that "the mine was well worth the price."

When a nurse tells a fairy story to a child, she will use many **verys**, which fall on the imagination of the child like a hailstorm on a flower-bed. The excessive use of **very** is childish; it makes a constant call for exaggeration. It becomes wearisome. If the reader will apply the test to the average writing of the day, he will find little is lost by omitting **very**, and much, though *not* 'very much,' may be gained thereby.

Other adjectives that are bullied in the same way by redundant adverbs are **straight, vertical, unique.**

"A very straight tunnel into the mountain."

"The vein is very vertical."

"A very unique child, said I."

"A rather unique gathering of our profession."

A thing is either **unique** or it is not, there is no degree of uniqueness. So also a thing is **vertical** or it is not; it is **straight** or it is crooked. Fortunately, there are a few words the meaning of which is unassailable.

Somewhat and Probably.—Anyone who hopes to write well had better begin by adjuring **somewhat.** It will also be well for writers to deny themselves the frequent use of qualifying adverbs, such as **perhaps, about, probably,** and **rather.** As has been said by an authority, this "intemperate orgy of moderation" amounts to a disease, especially among British writers.

1. "A sampling plant was built **perhaps** five years ago."

2. "A **somewhat** important development is announced from El Oro."

3. "The designs for an installation of any **considerable** magnitude should not be approved until," and so forth.

4. "The lode is **probably about** ten feet wide."

5. "The quartz is **rather** hard and the walls are **very** straight."

6. "He uses a solution of **about** 2 per cent cyanide, which is **perhaps** sufficiently strong."

7. "The mine is **about** two miles from the town."

8. "On the whole it is **perhaps** the largest property in the district."

9. "It is **rather** rare to see such a rich vein."

These examples will suffice; it is indeed an orgy of moderation. In every case the qualifying adverb is a mere frill, and can be dropped without loss of meaning. It reminds one of the custom that once obtained, among the managers for English mining companies, of initialing a statement of accounts and of adding "E. & O. E.," which stood for "Errors and omissions excepted." So every statement is subject to error, for is it not human to err? The qualifying adverb does not shift the responsibility, it only burdens the sentence. For instance, in No. 4, a man says the lode is "about ten feet wide"; we know well enough that the width of a lode varies from point to point, and that it may be 9½ ft. in one place and 11¼ ft. in another, so that the general statement that "it is 10 ft." expresses the fact; if you are speaking of a particular measurement at a specific spot it is better to say 10 ft. 3 in. or 9 ft. 9 in., than to use the qualifying **about.** It is an unscientific mode of expression; you know the width is ten feet or you don't; if you do know it, say so; if you don't, say what you do know. In the same way, in regard to the distance of the mine from the town (quoted in No. 7), to say that it is "about two miles" will not absolve you from error if it proves to be three miles, and as an attempt at accuracy it is but a pseudomorph, because the distance will depend upon which road you take. Moreover, in practical life, the exact distance is less important than the condition of the road; a four-mile haul over a good road will be less expensive than a two-mile haul over a bad one. Be accurate; don't merely affect it. A man who says "the lode is about ten feet wide" and "the vein is rather hard"

and "the ore is probably free-milling," is likely to state that it contains two ounces of gold per ton when on an average it carries only 10 dwt., and to estimate his ore reserves 100% too high.

The Unnecessary Plural.—A bad habit, which is becoming steadily worse, is the squandering of the plural. Writers speak of "the ores" of a mine and "the rocks" in which the lode occurs, when they have no idea of a variety or a number of either the one or the other. **Slimes, concentrates, fines, tailings,** and **sands** are all terms that are used by some people only in their plural form. It is a Mormonism of style. And apart from its incorrectness, it causes the loss of a useful inflection. If a mill produces more than one kind of 'concentrate' or a mine several varieties of 'ore,' it is possible to suggest the fact by the employment of the plural. Moreover, the excessive sibilant is unpleasant in compounding, as in 'slimes-plant,' 'sands-vat,' 'tailings-sump.'

A **concentrate** is the product of a process of concentration; if several such products are formed (as happens occasionally), they are correctly known as **concentrates.**

A **tailing** is the refuse from a metallurgical process; if the refuse from several processes or more than one mill should meet, the result could be described as **tailings.**

Many writers appear to be unaware that **concentrate** and **tailing** are dictionary words, for they use only the plural forms.

Thus: "The gravels rest upon the older schists of the region." But it was of a particular deposit of gravel that the writer of this sentence was telling, and the "older schists" stood for *one* particular formation of schist. The two unnecessary plurals only befog the meaning, which

is that "the gravel rests upon the older schist of the region."

The stuff that goes through a screen can be divided into 'coarse' and 'fine'; there is no need to pluralize the second into 'fines,' any more than there is to put the first in the uncomfortable position of 'coarses.'

Occasionally the loss of the plural will seriously hamper the expression of an idea, thus: "An experiment was made on two **sands** having the following analysis. (Then came the analysis.) Which of these two **sands** is the finest?" Incidentally, "finest" should be 'finer.' Or again, "As at El Oro, one can calculate exactly the extraction from a **sand** when the sizing test has been made." Now try to express the distinctions made in these sentences by the use of the plural only. Surely it is unscholarly, and therefore unscientific also, to throw away a grammatical inflection of so elementary a nature. It will be found that loose writers, that is, those who do not think clearly and therefore are willing to write muddily, will scatter their plurals in every direction; in this there is a profuseness that is in keeping with the exaggerations of irresponsible journalism. It is another example of the choice of the abstract for the concrete, a blunder that marks the unscholarly writer.

Per cent should be used only as a term of precision and when accompanied by an exact statement of quantity. Thus: "In treating this gravel an abundance of water is necessary, otherwise a great **per cent** of the gold will be lost." Here it is used in a vague manner, and the word **part** or **portion** would be more appropriate.

"But this class forms only a small percentage of the young men of this community." No percentage is given,

the statement is vague, and the word **proportion** should be substituted for **percentage**.

Excepting is often used in place of **except**, as: "Your definition is correct, excepting that you do not go far enough."

Similarly, **partially** is used where **partly** is required. "The vat was partially filled." **Partially** means with partiality, and it should never be used without considering the claims of **partly**. These errors, like the use of "experimentalize" in place of experiment, of "preventative" for preventive, are evidence of an effort to be impressive by using long words.

"**Consistency** is a jewel," but **consistence** is a quality belonging to molasses in a jug or to the slime in a cyanide vat.

'Suppositious' is a common error for **supposititious.**

Approximate and **approximately** are used too often as an elegant variation on **about**, as "He is approximately 90 years old."

Series is employed instead of **number**, even when there is no succession or connection between the events or objects mentioned, as "A series of scattered orebodies in the limestone."

There is a tendency to use **it** too much. Whenever at a loss for either a nominative or an objective, the scribbler throws an **it** into his sentence. Thus: "By the arrangement shown the centre of gravity will be low, and it leaves a compartment at one end." The "centre of gravity" leaves no compartment, the "arrangement" does so. We might say: "By the arrangement shown the centre of gravity is placed low, and a compartment is left at one end."

A similar criticism may be made in regard to the excessive employment of **them** and **their.** Thus: "Iron poles are to be avoided on account of the danger to linemen and their short life due to rusting." The linemen are not short-lived; and, though eventually they die, they do not rust; it is the iron of the poles that oxidizes.

"The slime from the mill is treated in a second plant and its contents are cyanided at a small expense." From this the reader might infer that the contents of the secondary plant were subjected to cyanidation.

Referring to limestone rocks, a writer says: "In the residual clays left by their dissolution the farmers frequently make low wages by gophering after the liberated lead." The farmers did not undergo dissolution, otherwise they would not have been able to go for the lead.

CONCERNING TITLES.

The title **Mr.** means nothing. There was a time when **master** or **mister** was a specific title of honor. It is so no longer. Similarly, **squire** denoted a shield-man or attendant on a knight. In England it is the custom to address a letter to your grocer as Mr. Henry Smith, but to address a letter to your friend as Henry Smith Esq. In America **Esq.** is used by a few people at Boston, but elswhere it is rare. **Squire** and **Esq.** are verbal derelicts of the feudal system and they possess historic interest, but they have nearly passed out of use. In America it is as correct to write to Mr. Roosevelt (in his private capacity*) as plain Mr. Theodore Roosevelt, as it is to write Mr. Henry Smith when you send your grocer his check in payment of the month's account. In England they still distinguish between amateurs and professionals by prefixing **Mr.** to the first and omitting it before the names of the second, so that you read of a cricket match in which Mr. Henry O'Brien bowled Jones. The latter did not lose his pronomen nor his title of Mr. because he was bowled but because he was a professional, the bowler (Mr. O'Brien) being an amateur. In cricket the adoption of this style has its convenience but, nevertheless, it is a humorous survival of a class distinction. In America the class distinction is gone, and so is that between the amateur and the professional; here amateurs are scarce, for we make a business out of sport; also we have no class distinctions, only differences of bank balances.

*In writing to the President officially, it is correct to address the envelope "To The President. The White House. Washington, D. C.," and to begin the communication thus: "The President: Sir—."

Therefore **Mr.** is meaningless and in technical writing it can be largely omitted. As a matter of taste it is preferable, and as a matter of accuracy it is better, to use the initials or the first name. Thus: "The engineer in charge of construction is C. E. Palmer" is better than writing that he was Mr. Palmer. At the second reference, it is usual to omit the initials and to say Mr. Palmer, as in ordinary conversation.

Never prefix **Mr.** or any other title to the names of the dead, that is the worst snobbery of all. Thus: "In the death of Kelvin, England lost a great investigator." "By the death of Charles A. Molson, the mining profession lost one of its leading members." To put **Lord** before the immortal dead is bathos and to place **Mr.** before the name of a vanished personality is like bowing to a mummy.

Then we come to the use of such titles as **Professor** and **Doctor,** with their abbreviations **Prof.** and **Dr.** In England only a physician is addressed as Doctor. Surgeons, veterinaries, and dentists are denied the privilege. So far so funny, but the custom mentioned has not prevented doctors of divinity and doctors of science from taking to themselves the title usually associated with the healing art. In America, it is chaos; the titles Professor and Doctor are employed so loosely that they are well-nigh meaningless. For my part I cannot see why a Master of Arts should not be addressed as Master if a Doctor of Philosophy is entitled to be called Doctor. Moreover, in the West, an Attorney General is usually called General and a Surveyor General is easily mistaken for a military chieftain of the highest rank. They are as much generals as the general dealer in merchandise or the man who has general supervision of street construction. In Kentucky

every gentleman is a colonel, at Washington every scientist is a doctor; in fact, my friends of the United States Geological Survey will, I trust, not be offended if I say that it is apparent, from official sources of news, that the chiefs are Doctors, the seconds in command are Professors, and the chain-bearers are plain Misters. One of the worst sinners in this regard is *Science*, the organ of the American Association for the Advancement of Science. The editor of that weekly magazine bestows his accolade with rare impartiality and gives degrees with unrestrained generosity. Lately, the list of contents gave the names of a Professor who was not—and never had been—a professor; of a Doctor, who was an M.A. and not a Ph.D.; of a Mr. who had won a Ph.D. from Columbia. The gradation of title merely expressed the editor's sense of the degree of courtesy it was proper to pay the several writers. Of course, such misuse of title is grotesque. We love to call some of the veterans 'Doctor,' for they got their Ph.D. at a time and at a place where the honor meant something; nowadays every little college grants doctorates, so that they have no significance unless the name of the grantor university is affixed. I remember a friend of mine in Colorado who was given an honorary Ph.D. by the State University because he was the promoter of a paper mill and other useful local enterprises, and my friend valued the honor chiefly because it made him eligible for the University Club at Denver. Furthermore, a doctorate does not indicate even the same degree, for Dr. Edward D. Peters and Dr. F. L. Bosqui are graduated physicians, although both have become authorities in metallurgy; they are not doctors of philosophy, as might be inferred. As to professor, that title belongs first to

the peripatetic corn-doctor and next to the instructor in dancing. At Harvard the professors are addressed as **Mr.**, and the unnecessary use of **Professor** in addressing lecturers is deemed provincial.

In a democracy there is no rank outside of the army and the navy, and among civilians good taste dictates the minimum use of titles. The true American has no superior, *and* no inferior. In Europe titles express positions, class distinctions, and social courtesies, and they form a part of the old-world customs; they have historic warrant. In America, they are solecisms. Therefore avoid the use of the prefixes Dr. and Prof. Say: Mr. C. R. Van Hise and not Dr. Van Hise; Mr. S. F. Emmons and not Prof. Emmons.

The following are examples of correct usage:

"Mr. James F. Kemp, professor of geology in Columbia University."

"He graduated from Cornell University."

"In deference to the wishes of Mr. S. B. Christy, the dean of the mining department of the University of California."

If it is desirable to state the fact that a scientific writer has had a doctorate conferred upon him or has held a professorship, then say it thus: "Richard Pearce, Ph.D., Columbia." "Courtenay De Kalb was formerly professor of metallurgy in the School of Mines of Missouri."

When you refer to persons bearing foreign titles, be careful to be correct, for to a foreigner they mean much and to be careless is either to be discourteous or to confess your ignorance. Thus, in speaking of an English knight or baronet, you speak of him as Sir John Smith, and at the subsequent reference you speak of him as Sir John.

In England the prefix 'Honourable' indicates that the bearer of it is the son of a peer, while 'Right Honourable' signifies that he is a member of the Privy Council. These quaint old customs have historic warrant and mean something in a country of anachronisms, however curious they may seem to an American. In a democracy we have no titles save those of the army and the navy, because only in the naval and military services is precedence recognized. The Kentucky Colonel will forfeit his title promptly when his purse is inadequate to the tips demanded by his honorary rank. The Attorney General of California, who is hailed as General, has no more precedence than the general grocer, to whose class etymologically he belongs.

MATTERS OF USAGE.

The split infinitive is not always avoidable; occasionally it serves to convey a special meaning. Avoid it if you can.

The omission of the definite article (**the**) before foreign names commencing with the definite article (**Le, La, Il**) recommends itself on the score of repetition, but it is likely to cause confusion. The French or Spanish article joined to another word is as much a part of the name as the noun itself, thus: "We have something interesting to show you in the Mexico mine and also in the El Oro" is clear, but the omission of the article before El Oro would suggest that there was "something interesting" in the district of El Oro, in which **the** El Oro mine is situated. Even in Spanish, one would say "*el distrito de El Oro*" or "*la mina El Oro,*" not "*la mina Oro*" or "*el distrito de Oro.*" So also we speak of "the La Rose mine" at Cobalt and "the Le Roi mine" at Rossland, and even "the Las Dos Estrellas mine" at El Oro.

Preposition Verbs.—The use of prepositions with verbs, and the consequent ending of a sentence with an insignificant word, is a defect peculiarly British, although not unknown on this side of the Atlantic. For example:

1. "The finest mine I **met with** in my travels."
2. "No large body of payable ore has been **met with.**"
3. "At that time it was intended to sink a shaft along the drive at a place where the new make of stone had **come in.**"
4. "The shares are being **dealt in** at a large premium."
5. "A road has been **reported on** as practicable."
6. "All but 200 tons was **operated on** in Pahang."

7. "The slime separated **makes up** a capacity of 500 tons per day."

8. "This is true in **dividing up** geological time."

9. "The influence of the old views has so **clung on** that the tendency has been to **give up** the idea of time."

10. "The vein has been cut, and new men will be **put on** to drift on it."

11. "The vein is **split up** into stringers."

12. "The disturbance **tilted up** the strata."

13. "End bearers 12 by 12 in. **let in** 16 in. into each wall."

14. "The ore is **fed in** at the curved end."

15. "The weak solution is **turned on** at first."

Many other examples might be quoted of the use of **let in, stop up, come in, carry on, make up, fold in, split up, open up, fill up, pour in, empty out, start up, close down, cave in,** and so forth.

It will be noted that usually the preposition forming part of the verb is followed immediately by another preposition; this is ugly. Moreover, while in speaking, the verb and its preposition may be held together so as to effect a separation from the following preposition, in writing this is not indicated. We do not write: "The finest mine I met-with in my travels," but we space the words equally, so that it might be read: "The finest mine I met with-in my travels." In German such verbs are frankly compounded, and if they are to be used in English it might be well to hyphenate them, but it would be better still to avoid the use of them altogether.

It was "the finest mine he saw" that he meant; he did not meet the **mine,** nor did the mine come forth to meet

him. Similarly, in the second example 'intersected' or 'found' would serve.

The third quotation is obviously Australian, for 'make of stone' betrays its origin, even if 'drive' (meaning 'drift') did not do so. In this case the new orebody had been 'cut' or 'exposed.'

The fourth is often to be read in financial papers; it can be circumvented by saying: "There were dealings in the shares at a large premium."

So also the fifth and sixth are common; we read that a mine has been **reported on**, etc. Why not say: "A report on the mine has been made."

In the seventh **makes up** should be 'constitutes' or 'forms.'

In the eighth, the preposition can be dropped, while in the next quotation both prepositions have some value and it is rash to suggest an improvement. We might say that "The influence of the old views has clung to geology so that the tendency is to abandon the idea of time."

In the tenth, eleventh, and twelfth the prepositions are redundant. In the thirteenth the confusion between the preposition **in** and the abbreviated form of 'inches,' is awkward. 'Projecting' into the wall or 'inserted' into it might express the meaning.

As to the fourteenth, evidently the ore is not fed **out**; the **in** is not needed. This is like **upraise**, which is found in some mine reports, as though anyone raised *downward*. In the fifteenth example **turned on** must be left as it is, with the ugly second preposition following it, or another phrase must be used. **Turn on** and **turn off**, as meaning to start or stop the flow (as in this case, of a solution), are required in technical writing because we have no

equivalent that will do duty for them. It is not intended to state that all these preposition-verbs can be dispensed **with**, but it is suggested that certain ungainly sentences can be modified to advantage by avoiding the use of them.

"The visiting engineer should be **put up** by the owner of the mine **on** the property." An Anglicism; a man is 'put up' when he is entertained, and if the hospitality is inadequate he must put up with it as best he can.

"Upon the melting **down** of the charge." How does this differ from the melting **up**? Many metallurgists prefer the latter, although the first suggests the subsidence that follows liquefaction of fragments. Neither preposition is necessary.

A mill is started **up** and then is closed **down**. In these cases the preposition gives added force and is excusable, though unnecessary and ugly. On the Rand the white men 'boss up' the coolies. We learn that "with the large machines almost half of the time was taken **up** in putting **up** and taking **down**." It reads like an obstacle race.

"The velocity of the escaping gases is too great to permit of the settling **out** of the finest particles." If the particles settle, they settle; that is enough. Of course, there are people who settle **down** in the country because they cannot settle **up** their debts in the city, but that is neither here nor there.

It is worth remarking that so clever a book as 'The King's English,' which offers an effective criticism of representative English writers, is guilty of the following sentences: "It is insulting to the reader, implying that he was not worth working **out** the sentence **for** before it was put down." After such a performance we venture

to express opposition to their approval of the termination of a sentence with an unimportant word, as will happen often when these preposition-verbs are employed.

A Western miner, who has overslept, will say that he has 'slept in,' and after he has been to the boarding-house he will state that he is 'full up.' A little later he will 'hide out' from the foreman by 'climbing up' into an 'upraise.' Why should we perpetuate the lingo of the illiterate? The miner has much to teach us, especially how to find ore and how best to extract it, but the selection of terms or the use of language is not his province, and he does not thank you for putting him in a false position.

In speaking or writing concerning technical matters, it will be found that there is an insistent multitude of preposition-verbs. If note is taken of their clumsiness and of the awkward sentences produced by the use of them, it is likely that they will be avoided. It is easy to do so. Try a re-arrangement of the sentence or a substitution of terms. It is good practice.

Most preposition verbs can be replaced advantageously by plain verbs; for example:

carry out	perform
look after	watch
fall off	decline
prove up	test
keep up	maintain
make up	compose
aim at	attain
go on	advance
work out	develop

Tautology.—"The shaft is being sunk deeper." A shaft must be sunk **deeper**, if it is sunk at all.

"The men on that shift drove the drift forward four feet." They would not be likely to drive it **backward** or even laterally, for then it would become a cross-cut.

"It is radically wrong **in its inception** from the start." Words, mere words. Those that are indicated are not needed.

"The manager began cross-cutting at shallow depths." If shallow, then not deep. Why not say where the manager did the cross-cutting? On which level? How far from the surface?

Payable means due as to payment or capable of being discharged by payment. It is used in mining as a synonym for **profitable**. The ore does not **pay** nor is it able to pay what is unpaid and due; the use of the word is to be condemned, for it was introduced by illiterate persons and is a blunder. We do not need **payable**; use **profitable**. **Pay-ore** is now a recognized technical term and is out of the reach of a protest.

It is better to say 20 ft. **wide** than 20 ft. **in width**. Similarly, 10 ft. **long** is preferable to 10 ft. **in length**. Except when *not* preceded by a number, as: "The orebody has increased in length as the mine has been deepened." Or: "This vat differs in breadth from the other."

The latter is employed in a confusing way; sometimes it is used where **last** is required. Thus: "I am using 18% coke on the charge and I may get to 17 or even 16%. The latter figure I hope to reach." Here there are three percentages; he means the **last** of them.

"Of these three main ore deposits, the Winthrop, the Rising Star and the Bully Hill, only the latter is associated with the diabase." A comma is needed after Star; and **latter**, referring to the last of three, should be **last**.

"The gangue minerals consist of calcite, quartz, dolomite, gypsum, and calamine, native silver occurring in vugs of the latter." **Occur** is overdone by many writers. **Latter** should be **last.** As gangue consists of minerals, necessarily, the use of 'minerals' is undesirable.

The Indefinite Pronoun.—As a rule, educated Englishmen use their own language skillfully, because they receive instruction in grammar while at school, and they are not in a hurry. Nevertheless, they have two peculiar faults. One of these is the use of preposition-verbs, as already mentioned; the other is the frequent employment of the indefinite pronoun **one**, as in:

"**One** would not be inclined to believe such a statement."

In some instances it becomes almost an obsession, as in the case of a man with whom I discussed the future of the Royal School of Mines. He said something like this: "Looking at the subject broadly, **one** would suppose that the Government would give better support to the plan, for **one** can see no reason why they should not do so; and certainly **one** has a right to expect something in behalf of so important an institution; but in matters like these **one** almost despairs of **one's** countrymen." It is a sort of mock-modesty, an exaggerated effort to avoid egotism and self-assertion. It may be that those of us who live in America are a bit too assertive, but at least we know our own minds and are willing to accept the responsibility for the statements we make, instead of fathering them upon a shadowy something that masquerades in the garb of a shamefaced pronoun. Examples of this peculiarly British habit are easy to obtain; here is one from a book (and a good book too) by H. G. Wells; speaking of the

dispersal of population by reason of improved locomotion, he says:

"The towns **one** inferred, therefore, would get slacker, more diffused, the country-side more urban. From that, from the spatial widening of personal interests that ensued, **one** could infer certain changes in the spirits of local politics, so **one** went on to a number of fairly valid adumbrations. Then again starting from the practical supercession of all unskilled labor by machinery **one** can work out with a pretty fair certainty many coming social developments, and the broad trend of **one** group of influences at least." And so he proceeds. Now, it happens that he is referring to his own opinions as expressed in a book previously published, and it is no indefinite person or public opinion or a debating society, but H. G. Wells, that is supposing and suggesting these interesting things. Put the first pronoun singular, the aggressive **I,** in the place of **one** and the whole statement gains vigor and an additional meaning, for these are *his* ideas, the ideas of a particular social philosopher and not of a chimera ruminating in a vacuum.

In the quotation from Wells, it will be noted that the numeral **one** occurs in the same sentence as the pronoun **one;** this is awkward. So also is the uncertainty as to whether **one** should be followed by a singular or plural pronoun. For instance:

"People here know that this kind of speculation gives **one** a run for **their** money." **Their** should be **one's,** but even that is awkward. Get rid of the **one.**

Of course, egotism is to be deprecated and the iteration of the first person singular is tiresome, but in technical writing, where definite statements are made by a specific

observer and personal investigations are recorded by individuals, it is a mere pretence of modesty to use these elegant variations. It detracts from the vividness of a statement without lessening the responsibility for it, and often it results in awkward circumlocution. The use of **writer** is also open to objections that far outweigh any considerations of taste or modesty; it may be properly regarded as an affectation that interferes with clearness of expression.

"The geology of the district is more complex than it has been described by Mr. Turner. The writer has discussed the subject in a bulletin, etc." Here the **writer** appears to refer to Mr. Turner, but it stands for his critic, the **author** of the above paragraph. By changing the last sentence to "I have discussed the subject, etc," the meaning is made clear. **Sacrifice elegance, even modesty, to directness of statement. Remember the reader.**

RELATIVE PRONOUNS.

Most writers employ **that** as an agreeable variation from the too frequent use of **who** and **which**; they regard **that** as interchangeable with the two other relative pronouns and make euphony the sole arbiter of their choice. However, among the helps to clear expression I include the proper use of these three relative pronouns. The neglect to distinguish between the functions peculiar to them severally is an error common to technical, as to ordinary, literature.

A relative clause is introduced by a relative pronoun; it has a subject and predicate of its own, and refers to, describes, or limits a previous word. The word or group of words to which a relative pronoun refers is called its 'antecedent'; as in the sentence "He in whom we trust," where "He" is the antecedent described by the clause "in whom we trust."

The relative pronouns serve as reference-words and connectives. **Who**, with its possessive **whose** and its objective **whom**, is both singular and plural. It refers to living things, usually persons, sometimes animals. By poetic license inanimate objects may be personified, so that we may speak of "the city whose future is assured." But it is not well to say: "The stamp whose descent on the die crushes the ore." It will be more correct to substitute **of which** and say "The stamp, the descent of which on the die, etc." This is correct; but it is awkward, which is a hint to reconstruct the sentence and omit the relative pronoun, thus: "The stamp, by descending upon the die, crushes the ore upon it" or "The stamp falls upon the die so as to crush the ore."

When in doubt, rebuild your sentence.

What always refers to things, never to persons. The antecedent to **what** is not expressed. Thus: "What will happen, no man can foretell."

Which is not inflected. It refers, with rare exceptions, to things only. **That** also is not inflected, it refers either to persons or things.

The main problem is the distinction between **that** on the one hand and **who** or **which** on the other. Grammarians and writers differ as regards the restrictive function of these relative pronouns. Thus: "The friends that I loved are dead" seems better than "The friends whom I loved," for it is the beloved friends as distinguished from ordinary friends that are dead. You say "The father whom I loved is dead," rather than "The father that I loved," because a man has only one father and the use of the term is sufficiently restrictive.

A useful rule for the use of **that** and **which** is given by Professor Bain and quoted by Edwin A. Abbott in his invaluable guidebook called 'How to Write Clearly.' It is: "When using the relative pronoun, use **who** and **which** where the meaning is 'and he,' 'and it,' etc., 'for he,' 'for it,' etc. In other cases use **that**, if euphony allows."

Thus: "I heard this from the mine manager, who (and he) heard it from the man that was in charge of the work."

Abbott also says: "**Who** and **which** introduce a new fact about the antecedent, whereas **that** introduces something without which the antecedent is incomplete or undefined. Thus, in the above example, "mine manager" is complete in itself, and **who** introduces a new fact about

him; "man" is incomplete, and requires "that was in charge of the work" to complete the meaning.

Let us go into the matter a little deeper; but before venturing upon controversial ground, I shall state one safe guide to lucid diction, namely, whenever a sentence appears doubtful in the light of a rule, it is likely that the sentence (not the rule) needs changing. **Grammar was made for man, and not man for grammar.**

Relative clauses are divisible into defining and non-defining; the function of the first is to limit the antecedent, this limitation being effected in several ways. In whichever way the defining clause does its work, it is essential to, and inseparable from, the antecedent. By this test it can be distinguished. Thus: "The process which will extract both the metals is likely to be adopted." In this case "will extract both the metals" is the relative clause introduced by **which.** The antecedent is "the process." The clause limits the kind of process referred to, by stating that it "will extract both the metals"; therefore, it is a defining clause and should be preceded by **that.** The sentence is better thus: "The process that will extract both the metals is likely to be adopted."

"The process, which is of recent invention, extracts both the gold and silver at a cost of 50 cents per ton of ore." Here the relative clause ("which is of recent invention"), introduced by the pronoun **which,** is non-defining; it merely gives a bit of incidental information, leaving it to the principal clause to predicate concerning the antecedent ("the process") that it "extracts both the gold and silver at a cost of 50 cents per ton of ore."

Exceptions will occur. **That** does not permit direct modification by a preposition. We cannot say "The man

in that we trusted," although colloquially we may say "The man that we trusted in"—an awkward clause, ending with a preposition. To 'trust' a man and to 'put your trust in' a man express two shades of meaning, of which the second is much the stronger. Finally, to serve the purpose, we say "The man in whom we trusted." Moreover, **that** is not available for all restrictive clauses, for it may make confusion with the conjunction **that.** Thus: "It was clear that that man could be of no service to me" or "We noted that the people that composed the mob were beside themselves." In both examples an unpleasant collision between the conjunction and the pronoun can readily be avoided by reconstructing the sentences. In the first, the two **thats,** if spoken, are differently accentuated, but the distinction is lost in the written words.

That when used of persons, has come to look archaic and **who** is preferable, except when the antecedent has attached to it a superlative. We say:

"He is a man who dreams all day."

But we may say:

"The most impartial man that I know."

Let us proceed. The removal of the defining clause destroys the meaning of the antecedent. This is a sure test for distinguishing the defining from the non-defining clause. Thus, in the sentence: "The process that will extract both the metals, is likely to be adopted," if the clause "that will extract both the metals" be omitted, the sentence becomes meaningless, for to say that "the process is likely to be adopted" without indicating in any way the particular process, would be senseless. In the other example: "The process, which is of recent in-

vention, extracts both the gold and silver in the ore at a cost of 50 cents per ton," the non-defining clause "which is of recent invention" can be detached without interfering with the significance of the principal statement that "the process extracts both the gold and silver, etc." Countless processes are "of recent invention" but only special processes will "extract gold and silver at a cost of 50 cents per ton of ore."

Furthermore, a non-defining clause gives independent comment, description, or explanation—anything but limitation of the antecedent. In the last example, the relative clause can be written either as a parenthesis, or as a separate sentence, thus: "The process (which is of recent invention) extracts, etc." or "The process is of recent invention and is said to extract both the gold and silver, etc." This cannot be done with the defining clause in the preceding example without decapitating the sentence, for "the process (which will extract both the metals) is likely to be adopted" or "the process is likely to be adopted and it will extract both the metals" are both badly expressed.

To ascertain whether a clause does (or does not) define, remove it, and it will at once become apparent whether it is essential; if it is essential, it defines. Ambiguous cases are frequent, because some clauses are capable of performing either function and an undiscriminating writer may fail to make himself understood. The uncertainty, as to whether the clause is limiting or descriptive, can be obviated by making plain what is the antecedent. **Rewrite the sentence, so that the meaning becomes clear beyond peradventure.**

Punctuation should be a guide in most doubtful cases, for the non-defining clause ought to be preceded by a

comma. But this test is not reliable, simply because punctuation is often slighted. This much may be said: The information given by a defining clause must be taken at once, with the antecedent, or both are useless; while the information given by a non-defining clause will keep, the clause being complete in sense without the antecedent.

A few examples will serve to illustrate. The first three are taken from one of my own books, written before I paid attention to the nicety of these distinctions.

"A good millman has the clarified common sense which lies at the basis of true science." Here the last clause defines, the reference is to a special kind of common sense, namely, *the* kind that "lies at the basis of true science." However, in this case no misunderstanding is caused by the use of **which**, the clause carries the meaning of limitation in either case, and no harm has been done. Yet, the sentence is clearer and stronger with a **that**: "A good millman has the clarified common sense that lies at the basis of true science."

"That interval of time is utilized in the shifting of the material which the hammer blows are shaping." Here **which** is evidently an elegant variation from **that**, which has been used just before. The antecedent (material) is defined by the relative clause, which describes it as the particular material undergoing shaping by the action of the hammer. Therefore **that** is required in place of **which**. But, even more certainly, the sentence requires change. The **that** before "interval" might well be changed to **this**, for the reference is to an "interval of time" previously discussed. As soon as **this** is used the hankering for euphony is satisfied and the **that** before "the hammer" becomes comfortable.

"The hammer which cracks open the nut may liberate the kernel without crushing it." This also may be amended, for the antecedent (hammer) is limited by the clause as one that "cracks open the nut." Therefore **that** is better. Here also no particular harm is done, for the meaning is not upset, as it is in the additional examples (taken from other authors).

"The Trail smelter is treating ore from the Sunshine mine at a profit which only runs 1.4% in copper, $1.50 in gold, and 23 cents in silver." This says that the "profit" runs so much, but it is the "ore" that contains the metals mentioned. The clause introduced by the relative pronoun in this instance is defining and the information given must be taken with the antecedent, which is "ore," not "profit." "At a profit" is incidental and only needed for emphasis, since ore is not "treated" usually except "at a profit." Re-arrange the sentence, thus: "The Trail smelter is treating, at a profit, ore from the Sunshine mine that runs only, etc." Or "The Sunshine mine is sending ore to the Trail smelter and this ore yields a profit, although containing only, etc."

"There is a singular absence of oxidation in these orebodies which may be due to the protection afforded by the 'drift' which has in the Glacial period mantled the whole district." Is the oxidation or are the orebodies due to the protection of the 'drift'? It is a mark of the non-defining clause that the information it conveys may be postponed; it need not follow immediately on the heels of the antecedent. In this case **which** introduces the clause referring to the "oxidation"; therefore it is correct, though the sentence is ambiguous. But in the latter part of the same sentence there comes another relative clause

describing the 'drift' and limiting it by stating that it is "the Glacial drift" responsible for the alluvium "mantling the whole district." There might be other kinds of 'drift,' formed in other geological periods and distributed over parts of the district, but this is not one of them; the clause defines, and the relative pronoun should be **that**. The mere doubt as to the meaning indicates that the sentence needs to be re-arranged, as thus:

"In these orebodies there is a singular absence of oxidation, which may be due to the protection afforded by the 'drift' that mantled the whole district during the Glacial period."

"The law has many defects and contains a number of clauses which should be changed as soon as possible." There are certain "clauses" requiring change, those that are "defective" should be changed; the clause is definitive and not incidental. **That** is preferable to **which**.

"The elevation which occurred in Pleistocene time and which affected the American river, may have had some influence on the Yuba." The question is as to whether the writer refers to a particular elevation occurring in the Pleistocene period as distinguished from others that happened earlier or later. Or does he refer to a solitary elevation during Pleistocene time? The context shows that he is speaking of one out of many elevations and that he indicates a particular one occurring at a particular period and causing specific geological changes, therefore the sentence ought to read: "The elevation that occurred in Pleistocene time, etc., may have had some influence on the Yuba." The second **which** (preceding "affected") is justified by the first (after "elevation"), and the doubtful use of one suggests the advisability of elimi-

nating the second by a reconstruction of the sentence. **When in doubt, re-write your sentence. A doubtful meaning is much worse than doubtful grammar.** The sentence may be changed thus: "The elevation that affected the American river during Pleistocene time may have had some effect upon the Yuba also."

"There is a mine in the downtown district which is in a position to furnish large quantities of manganese ore." The 'downtown' is a part of the Leadville district within, and adjacent to, the city itself. The question arises: Is the "mine" or the "district" to furnish the ore? The sentence says the latter; other information points to the former. The two can be harmonized by employing **that.** Avoid ambiguity and rebuild the sentence, thus: "In the downtown district there is a mine that is in a position to furnish large quantities of manganese ore." The antecedent (mine) calls for definition and marks the clause following **that** as belonging to the limiting kind. As re-arranged the meaning of the sentence is unmistakable and even the use of **which,** though erroneous, would not obscure the statement of fact.

"The manager cut a vein in the Brooklyn ground which was developed at the 800-ft. level." If the reference is to the "ground," then **which** is correct, but it should be preceded by a comma. If the "vein" is referred to, then **that** is required because the clause defines the particular vein "in the Brooklyn ground" and "developed at the 800-ft. level." The context proved that the latter was meant. The doubt indicates that the sentence requires change. It might be re-written thus: "The manager explored the Brooklyn ground and cut the vein that had been developed at the 800-ft. level." Which 800-ft. level?

It was the 800-ft. level of the mine adjoining the Brooklyn. Let us call it the New York. Then we get at the true meaning of this cryptic sentence, thus: "The manager did some work in the Brooklyn ground and thereupon cut the vein that had been previously explored at the 800-ft. level of the New York mine, which adjoins."

Occasionally even when **which** is correct, it is advisable to substitute the equivalent **and it,** thus: "According to my tests 58% of the assay-value of the ore could be saved by a series of concentrations which, owing to the careful adjustments necessary, is not always obtainable in every day working of the mill." This can be improved, for the second sentence tumbles all over the first so as to confuse the idea to be conveyed, like two horses in tandem that want to turn round and shake hands with the driver. After the word "concentrations" put a dash (to express the break in the sequence of thought) thus: "—and this, owing to the careful adjustments necessary, is not always practicable." A further improvement can be made by substituting **but** for the **and. Practicable** gives the exact intent of the eight words for which it is substituted.

It is interesting to note that this distinction between the uses of the relative pronouns is observed in Elizabethan writers, notably Shakespeare himself. Many modern authors disregard it. To technical writers it will be found a convenience in attaining lucidity of expression.

For the sake of euphony, when the conjunction **that** has just been employed or when the antecedent is qualified by **that,** it may be necessary to avoid a disagreeable repetition of the word. Then use the participle, as "Men working underground" in place of "Men that work

underground." Or use the infinitive, as "He was the first manager that succeeded in making the mine profitable" may be changed to "He was the first manager to succeed in making, etc." Similarly, if **which** is overworked, substitute **and this**; thus: "He worked hard, which was all that he could do," can be written "He worked hard, and this was all, etc." Then, if despite these variants, the sentence is still overburdened with relative pronouns, there is one remedy: **Re-write and re-arrange. It is not the fault of the language, but yours.**

I am aware that no part of the present writing is so open to criticism as this attempt to elucidate the use of the relative pronouns. It is likely that in my effort to emphasize the neglect of one of them, I shall be charged with undue partiality for **that** and a prejudice against **which.** The attempt to state useful rules may read like an effort to establish irrefrangible laws. Our language, so the critic will say, has other devices to mark the restrictive clause and it is easy to avoid the monotony of an arbitrary rule. For instance, the definite article **the** attached to a noun not previously made definite in the context, distinctly points forward to the relative clause, or whatever may take its place, as a limiting expression. Professor Whitney says: "Some authorities hold that **who** and **which** are to be used as co-ordinating or simply descriptive relatives, but **that** as limiting a descriptive. . . . But the best English usage by no means requires such a distinction."* Again it may be asserted that "the relative clause is not necessarily of one sort or the other, it is frequently both, or hovers delicately on the margin between the two." So says Professor Bradley of the University of California.

*'Essentials of English Grammar.' Page 77.

He also argues against any attempt "to force speech into a cast-iron mould in defiance of its chartered freedom of ages. Every predication about a thing, no matter what its form, logically limits it, defines it, narrows the concept."

So it is well to go gently. As a matter of fact there is no arbiter in such matters, save the reader. Put yourself in his place. Use such words as will best enable the transfer of thought with least worry to the recipient. In some cases you may avoid ambiguity by using **that** instead of **which**, in other cases **that** is no better than **which** and only serves as a stumbling block to the transfer of ideas. So I apologize if my statements have seemed too arbitrary; my purpose is simply to stimulate the attention of technical writers to some details of their literary mechanism.

This discussion concerning relative pronouns is worth while, if for no other purpose than the light it throws on the necessity for re-constructing doubtful sentences. Grammar is worthy of respect, euphony is desirable, idiom is not to be neglected; but precedence must be given to clearness of statement. Sacrifice everything to this attainment and you will find that you have included most of the other qualities. It is seldom necessary to forego any of them, for the resources of our language are equal to all the demands of exact and felicitous expression. Be lucid, and all these other qualities shall be yours, as you desire them and practice to attain them.

EXAMPLES OF JOURNALESE.

1. "The strike in the Ophir mine has been demonstrated to be of a **permanent** character." This refers to the finding of ore; the writer means that the lode has been proved to be **persistent.**

2. "This is no secondary enrichment, it is a **permanent** orebody." Here also **permanent** is used instead of **persistent** or **continuous.**

3. "The principal work being **prosecuted** at this time is in the shaft."

4. "The Butte & Arizona Co. is **prosecuting** development work with vigor."

5. "A vigorous campaign of development is being **prosecuted.**"

Certainly, the writers of these sentences ought to be prosecuted. In the first example, the word 'done' would serve the purpose and in the second 'pushing' would suffice. The third quotation is an example of disproportionate language, for it happens to refer to unimportant mining operations, and it might have been stated that "steps have been taken to develop the mine rapidly" or "it has been arranged to sink the shaft without delay."

6. "It is announced that concentrating facilities will be provided for near the mouth of the tunnel," meaning thereby that a concentrator is to be built near the mouth of the adit.

7. "The Frisco Co. is unable to place its new equipment in commission." That is, the company is unable to start its new machinery (for lack of fuel).

8. "Vigorous cross-cutting is being **inaugurated.**"

9. "The **inauguration** of an extensive plan of development."

10. "An extensive campaign of development has been **inaugurated.**"

11. "Ore shipments have been **inaugurated.**"

12. "Work on a 50-ton mill is to be **inaugurated** in September."

13. "**Extensive** improvements have been made."

14. "An **extensive** mine equipment has been provided."

Both **extensive** and **inaugurate** are good words in the wrong place. **Extensive** means extended widely; in No. 10 it is not misplaced, but in No. 9, 13, and 14 'elaborate' is meant. In No. 13 'big' would probably do, and in No. 14 'expensive' may be surmised. As to **inaugurate,** that word, like **prosecute,** is merely grandiose. The President is inaugurated, not a "plan of development." In No. 8 'started' is meant; in No. 9 **inauguration** should be 'commencement'; in No. 10, 11, and 12, 'begun' or 'commenced' will serve.

15. "A new tramway is being **installed.**" It is being 'erected' or 'built.'

16. "A large **per cent** of the mining and milling **installations** are designed by machinery builders." **Per cent** is wrong; it should be used only as a term of precision with a number, here it means merely 'portion' or 'proportion,' that is, "A large proportion of the mining and milling machinery was designed by manufacturers." **Installation** is a pretentious word. You **install** or **induct** a man into office.

17. "Since the **installation** of the air-compressor, operations have been **extensively prosecuted.**" Thorough jour-

nalese. **Installation** is out of scale, for a two-drill compressor has been erected to hasten the work or to enlarge the scale of it. **Installation, inaugurate,** and **prosecute** are words that are the stock-in-trade of the boosters of wildcats.

18. "As soon as the heading has been advanced far enough, **drifting** both east and west is to be **inaugurated.**" Here **driving** is required. You **inaugurate** a new reign or a presidential term, but you do *not* inaugurate the driving of a level or the cooking of an egg.

19. "In some instances the adoption and encouragement of the contract system has proved most advantageous **and efficacious.**" An example of tautology; the last two words serve no useful purpose.

20. "A mine in which the company recently acquired **extensive** interests." Here the objectionable word means simply 'large.' It might be **expensive,** but *not* extensive, for interests (that is, holdings) are not measured by their length, but their size or their value.

21. "The first **extensive** shipment came from the 425-ft. level." 'Important' or 'large' can be substituted.

22. "In the earlier working of the mines, tunnels of considerable length—approximating some twelve miles or more—were driven for the drainage of seepage." This should read "In the early working of the mines adits of great length—twelve miles or more—were driven to drain the seepage."

23. "Limestone of any character in the producing **sections** of the district seem equally **prolific.**" This should be: "The different limestones in the productive areas of the district seem to be alike ore-bearing." **Prolific** is not justified. **Sections** is colloquial.

24. "As it was a *sine qua non* that this shaft should be sunk 100 ft. within three months." The subject does not warrant a Latin quotation, nor does the sense require it. The use of Greek or Latin, French or German, where English suffices is a mark not of the literate, but of the pseudo-literate, man. The sentence can be improved by saying either that it was **necessary** or **a condition of** the contract that the shaft should be sunk as stated.

25. "It is a foregone conclusion that had it been possible to build a mill, a large amount of low-grade ore, carrying **more or less value,** would have **undergone a method** of treatment, rather than be thrown over the dump." Sloppy writing. If it had **no value**, it would not be ore; the **more or less** is only the pretense of accuracy. An ore does not undergo a method, it undergoes a treatment. The sentence may be amended thus: "It is certain that if it had been possible to build a mill, a large amount of low-grade ore would have been treated, instead of being thrown over the dump."

26. "The ores of the Bully Hill district contain much higher **values** in gold and silver." The writer means, and he ought to say, that: "The ores, etc., are richer in gold and silver."

27. "A six inch streak of ore is exposed that carries **values** from assay tests varying from 1000 to 1500 ozs. in silver to the ton." This is as full of errors as a watermelon is of pips. Hyphens are needed between **six** and **inch,** also between **assay** and **tests**. The streak of ore carries not **values** nor algebraic formulae, but metals; in this case, silver. The plural of the abbreviation **oz.** is inexcusable. The sentence may be amended thus: "A six-inch streak of ore is exposed, carrying from 1000 to 1500 oz.

silver per ton, as determined by assay-tests." If it is important to bring out the fact that assays have been made, it is well to add the last clause; as a rule the determination of the contents of an ore requires assays.

Some of the Worst.—Here is one describing the operation of a machine-drill:

"Following the shooting, the **mucker** begins his work, the drill man climbs to the top of the **muck**, and by the time the four feet of ground shot down is **mucked out**, he is again ready to shoot his round of holes." **Muck, muck, muck**—it is the very muck of writing. The word means filth or manure. It became used as a synonym for **dirt**, the miner's term for broken rock. Thus **muck** refers to the shattered rock resulting from blasting; it is not in the least filthy. **Shovelers**, that is, those who shovel the broken rock into the car at the face of a level or cross-cut, are now called **muckers**. What gain is there here? **Shoveler** is significant, **mucker** is the rubbish of words.

The next example comes from a description of the small locomotives used in mines. It reads:

"Face gathering, wherein the locomotive must enter the room, imposes conditions which call for distinctly special treatment in the design and equipment of a locomotive of high efficiency. The ordinary haulage locomotive in nearly all cases is totally unfitted to this work, which involves operation in narrow quarters, around sharp curves, over poorly laid tracks, etc. The locomotive of real value in room work is one which, by reason of proportions and construction, will go wherever a mine car will run, and with equal facility. It must be compact, no wider than the wheels, with short wheel-base and small wheels, and without long overhang at either end."

This is the sort of thing that makes a technical description seem like a cryptogram or a slab of picture writing from Nineveh. To any one versed in the subject of locomotives for underground use, this paragraph is intelligible, but only that. It succeeds in making the subject as uninteresting as possible and the meaning as much beneath the surface as the locomotive itself.

Both of these examples come from 'write-ups,' the trade name for a eulogistic description of a manufactured article, prepared in the interest of the manufacturer and written by a man more accustomed to the use of a screwdriver than a pen. The worst writing concerning technical matters is to be found in such disguised advertisements. They ought to be attractively written, to serve their purpose; failing to do so, they illustrate the essential inefficiency of bad writing.

Similarly: "The Union Leasing Company has **encountered** a promising vein 10 ft. north of the shaft." You can, if you are not unsympathetic, visualize the episode and, with the eyes of the mind, you will see the company going forth to meet a promising vein, and shaking hands with it at a place 10 ft. north of the shaft.

Exploitation and **exploration** are often confused. **Exploit** means to put to use; **explore** means to search. **Exploitation** refers to the extraction and utilization of ore; **exploration** refers to the work involved in looking for more ore. Thus (speaking of faults): "In certain cases, by judicious **exploitation,** the veins have been recovered and production continued." Obviously, **exploration** is meant.

"The **exploration** of the mine has yielded a large output of excellent ore." While ore is broken in the course of

exploratory work, it is fairly certain that **exploitation** is intended in this case.

"It is good policy to do some further **exploitation** work in search of the faulted vein." Here, 'exploratory work' is meant.

"There is a six-inch calcite vein with low silver **values located** on the property **which** crosses the main vein." Does the 'property' cross the main vein or it is the 'calcite vein' that does so? Many corrections are needed. The sentence should read: "On the property there is a six-inch vein of calcite, poor in silver, and this small vein crosses the main vein."

"It is quite clear from local information **that** the manager has gathered **that** large bodies of ore will be found." Probably it was no clearer than the construction of the sentence. The relative pronoun **that** and the conjunction **that** are used in a confusing way. Is it "clear, from local information, that the manager has concluded that large bodies of ore will be found," or is it "clear from local information, collected by the manager, that large bodies of ore will be found"? We presume the latter to be correct.

Contemplate is a word dear to the chroniclers of wildcat operations. The promoters of feline finance "contemplate the inauguration of a campaign of production," the "installation of a mill," or the "placing of a smelter in commission." Thus: "The Granite Mining Co. is **contemplating** the starting of the pumps." You can almost see them; a group of thoughtful men staring at the pumps and expecting them to be willed into movement.

Estate is another word belonging to the jargon of the promoter, for it suggests enough of fixed ownership to obscure the fact that the property consists of a number of

unpatented claims, the title to which may be lost by failure to do the assessment work. So "the **estate** of the Manhattan Morgan Corporation will be actively explored, the directors having decided to **prosecute** a vigorous campaign of development," which, being interpreted, means that they intend to sink a few prospect holes in order to have an excuse for selling their heavily watered stock. Grandiose language usually indicates flamboyant finance.

Many clumsy sentences and awkward locutions may be avoided by a little restraint in the use of prepositions; they are often meaningless little obstacles interjected into the flow of speech.

Technical words are designed for a specific purpose, as tools are kept apart for special duties. It is a mistake to open a can of sardines with a chisel. Such use blunts the chisel and destroys its service in carpentering. The significance of words intended for special uses is impaired when they are made to do a common service, for which other words are available.

HINTS IN GRAMMAR.

Subjunctive.—In conditional sentences the use of the subjunctive mood is correct, but it is dying out so rapidly as to make it seem an affectation, except in the case of **were** for **was**. On the whole, the subjunctive forms are best avoided in technical writing, as being unnecessary, and dangerous to all save the most practised writers.

Shall and **Will.**—The idiomatic use comes so naturally to a small minority that they know not how they do it, while to the majority misuse is so ingrained that rules are ineffective. The directions for the employment of **shall** apply to **should**; and those referring to **will**, apply also to **would.***

1. When **shall** and **will** retain their original meanings of command and wish, respectively, they are used in all three persons unchanged. Thus:

Thou shalt not steal.

You should not say such things.

Whom should he meet but Jones.

I will have my way.

I would not have it done for the world.

A coat will last two years with care.

2. In plain statements as to the future, the first person has **shall**, while the second and third persons have **will**. Thus:

I shall, you will, die some day.

Shall I, will they, be here tomorrow?

We should, he would, have consented if asked.

I should, you would, like to go.

*These rules are taken, with most of the illustrations, from 'The King's English.' Clarendon Press, 1906.

3. In future and conditional statements that include an expression of the speaker's wish, intention, menace, assurance, consent, refusal, promise, and so forth, the first person has **will**, while the second and third persons have **shall**. Thus:

I will tell you presently.

You shall repent it before long.

He shall not have any of it.

We would go if we could.

They should have had it if they had asked.

I will drown and no one shall save me.

There are other rules, with their exceptions, but for technical writers these three will suffice. The second rule is the one oftenest broken, without excuse.

The Possessive Case.—This is used excessively, and in cases where the preposition **of** is desirable. Thus: "The ore has been compared to a nut struck by a hammer whose blow has separated the valueless shell (the quartz) from the valuable kernel (the gold)." **Whose** is the possessive case of **who**; **which** is not inflected and it is as the possessive of **which** that **whose** is employed in this case. In poetry and by a personification of the thing mentioned, it becomes proper to use **whose**. Thus: "The city whose towers he saw in the distance." In the example quoted above, "hammer" is not used in any personal or poetic sense, and it should read: "A hammer the blow of which has separated, etc." If this sounds queer, re-write the sentence and avoid the dilemma.

Similarly, **its** is often used where **of it** would be better. Thus: "The mine is valuable and its development will furnish scope for an able man." It is more correct to say, "and the development of it will furnish scope," for the

mine does not possess a development, that engineering result being a consequence of operations performed.

"Clever chemists invent processes whose success hinges on their application in practice." This can be improved thus: "Clever chemists invent processes the success **of which** hinges on the application of them in practice."

It may be a matter of taste and the want of it; those that doubt the advantage of using the preposition in place of the possessive (of them, of it, of him, etc., in place of their, its, his, etc.) should read Ruskin. But apart from literary form, with which the technical writer is supposed to have no concern, it is a fact that the careful use of grammatical inflections will enable him to express himself more clearly, and that is the whole purpose of the present criticism. For it can readily be retorted that Ruskin mixes his **which** and **that** in order not to interfere with the marvellous assonance of his writing and to preserve a euphony characteristic of a prose style that is finer than poetry, but the technical writer, whom we have in view, aims simply to make his meaning clear, that is, to convey his ideas on practical subjects with the minimum of ambiguity. In poetry, ambiguity may add a charm; in technology, it is a nuisance only. Therefore, keep in mind the rules of grammar, and when the application of them produces a result that is not euphonious or gives a sentence of doubtful meaning, you will know that it needs re-arrangement. In most cases you will find that grammar has been respected at the expense of idiom or both at the cost of lucidity. Make everything subserve the purpose of your writing, that is, to be understood beyond peradventure.

The use of a singular verb with a plural noun is a locu-

tion that bothers many people. It is correct to say that "500 tons of ore is treated daily," because "500 tons of ore" is an aggregate and performs the function of a collective noun. The idea is of a quantity of ore as a whole, all of which is treated in a continuous operation. But it is proper to say: "Five tons of ore were tested in lots of one ton each with different cyanide solutions so as to ascertain which strength of solution would give the highest extraction." Here the idea is of five different entities, each of which was treated by itself. So we say:

"A hundred tons of ore is shipped to the smelter, while 350 tons is milled at the mine."

To many this locution is offensive because it carries an illogical idea; therefore, avoid it by using a different phrasing when possible.

MINOR MATTERS.

Punctuation.—This is a subject fitter for a chapter than a paragraph, but the limits of this little essay will not permit of an exhaustive treatment. The aim of punctuation is to indicate the manner in which the writing is to be read; it "does for the eye what vocal stress does for the ear." Barrett Wendell summarizes the uses of the four principal marks of punctuation thus: "The period is the strongest mark of punctuation; it marks the limits of sentences. The next strongest mark is the colon; weaker, but still stronger than the comma, is the semicolon; weakest and most frequent of all is the comma."* Herbert Spencer adopted the plan of placing actual spaces between the groups of sentences dealing with the separate ideas expressed in a single paragraph. Undoubtedly we could mark the varying duration of vocal pause between words, clauses, sentences, and paragraphs by blank spaces of graduated length, but punctuation marks are deemed the most effective way of doing so.

Abrupt change of thought and opposition of ideas is indicated by the dash, which is overworked by amateurs. The colon suggests a sequel; it serves to introduce a specific statement. It used to be employed to indicate consequential statements: those prompted by the thought preceding; but for such a purpose it has become customary to adopt the semicolon. The latter is now a misnomer, for it is not a half-colon, rather, it is what it resembles, namely, a compromise between the period and comma, the two marks of which it is built. The interrogation point (?) and the exclamation (!) are used but little in modern

*'English Composition.' Page 83.

writing, being deemed affected, for the ideas of doubt and astonishment are expressed more incisively by words than by punctuation.

The comma is needed before the last member of an enumeration that includes three or more. Thus from "Dick, Tom and Harry arrived today," it might be inferred that Tom and Harry arrived in company, and that Dick came by himself. To take an example from technical writing: "This card system divides itself into several parts, namely, correspondence, technical information, catalogues and miscellaneous." This means that there are three sub-divisions, one of which is "catalogues and miscellaneous"; if, however, a comma precedes the **and**, the sentence will mean (as intended) that there are four sub-divisions, as stated. Also the sentence, "He left a wife, son and daughter," The son and daughter become Siamese twins.

The utility of this function of the comma is seen in the following example: "To obviate excessive expense for power, stoping and hoisting must be done in the daytime." Here "stoping and hoisting" are purposely joined in opposition to "power," as would not be the case, for example, if a writer were in the habit of saying, incorrectly, that "power, stoping and hoisting are three important items of expense." The example quoted at the beginning of this paragraph cannot be misunderstood by those accustomed to write "power, stoping, and hoisting are three items of expense," using a comma before the **and**, to mark the grouping.

The double quotation mark "—" should be used only to indicate matter actually quoted from a speaker or a writer. The single quotation mark '—' should be used in giving titles of books or articles, as Bosqui's 'Cyanide

Practice.' "He read a paper entitled 'Secondary Enrichment of Ore Deposits'." Use the single quotation also for special or local technical terms, as 'mundic,' 'gusher,' 'fossick,' 'mucker,' 'black jack,' The single quote is apologetic and indicates words not yet accepted in good literature, such as 'graft', 'wild-cat', 'shyster', 'duffer', 'rebater.'

Carboniferous is the name of a geological period, which in England (where the term originated) was identified with the formation of coal, but the coal measures of other countries belong to different geological periods, such as the Cretaceous and Tertiary. **Carbonaceous** means containing or yielding carbon. Some writers use 'carboniferous' when they mean 'carbon-bearing' and this makes confusion with **Carboniferous**; for instance, in Missouri there is a Carboniferous limestone that is carbonaceous. Thus: "The mineral solutions came in contact with the carbonaceous material of the lower Coal Measures or some other precipitating agency." Give words their special duties and so strengthen their significance. Let **Carboniferous** stand for the name of the formation, and **carbonaceous** refer to richness in carbon.

Region refers to a large territory of ill defined extent; **district** is applied to a defined and relatively small area. Thus: "The Silverton district is one of the most productive in the San Juan region of Colorado." "The Wardner district is part of the Coeur d'Alene region of Idaho." "The zinc and lead mining region of southwestern Missouri includes the Joplin, Webb City, Carterville, Oronogo, Galena, and Baxter Springs districts." "In the Rocky Mountain region the principal mining centres are

at a high altitude, as, for instance, the Leadville district, which is two miles above sea-level."

Camp is often used as a synonym for **district**, but it becomes a misnomer when once a mining settlement has passed out of its tented or temporary stage of growth. **Field** is employed by Englishmen much as **camp** is used by Americans. "The goldfields of Australia are south of the equator." "On this (the Rand) field white labor is at a discount." "The zinc field of Missouri is prosperous." "The coalfields of West Virginia."

By compounding, the bucolic suggestiveness of 'field' is lessened, so that we employ 'coalfield' and 'goldfield' without a sense of incongruity. Compare 'battlefield.' But as mines are usually in the mountains or on the desert, the use of **field** may well be avoided as being without significance, if not misleading. We have **region, territory, tract, area, district, belt.** Let the farmer have his **field** and the soldier his **camp**; the miner has words enough for his own purpose.

The word **balance** is used too often as the equivalent of **remainder.** Thus: "The flume has been re-built for a greater part of its length and the balance will be thoroughly repaired." **Balance** suggests equalization, an effort to produce equilibrium or to keep in due proportion. Here it means the remainder or smaller part of the flume. There is no suggestion of poise or adjustment.

Latinity.—Elsewhere* I have attacked the employment of words of Latin origin when plain English will serve the purpose. The excessive use of long technical terms is becoming less common as it is realized that they are often unnecessary, besides being ugly and pretentious.

*See Appendix.

We leave them nowadays to the charlatan. Yet some good men err that way, thus: "The mineral is non-cupriferous and auriferous." This was written by a quiet thoughtful writer usually free from pyrotechnics. Is it not better to say that "the mineral contains gold but not copper."

In their effort to splurge, some writers use **silicious** when they mean carrying quartz, which is a particular form of silica; they use **metasomatic** until it becomes only a wordy cloud; and when they say **calcareous**, it is uncertain whether they refer to the presence of aragonite, calcite, or limestone, or merely a composition that includes calcium oxide. They use a long word that is comprehensive but indefinite in place of a short word that is less pompous but more definite. Such writers use **data** and **strata** as if they were singular nouns—a lapse to be debited occasionally against university graduates!

SPECIFICATIONS.

In preparing manuscript, write on one side of the paper only and use sheets of uniform size. Use the typewriter, if convenient. If written by hand, print all proper names carefully. Allow space between lines so that corrections can be made without crowding. A foot-note should be written in the manuscript immediately under the place to which it refers, and a line should be drawn across the page both above and below it. Foot-notes should be carefully given. An asterisk or other sign may serve to correlate one or two notes, but when many foot-notes are necessary it is best to number them, thus:

[1]R. A. F. Penrose 'Tin Deposits of the Malay Peninsula'; *Trans.* A. I. M. E., Vol. XX, pp. 64 to 92.

[4]*Journal* Amer. Soc. Nav. Eng., Vol. II, Pt. 3, p. 17.

In referring to authors or the names of persons, give the initials. Exercise care in this detail. Any man has a right to be annoyed if his name is spelled wrongly, for it is the one thing that is peculiarly his own.

In tabulated statements, the head of a column should end with a period. Headings should be uniform as regards abbreviation. Single words or the first of the several words in a description should begin with a capital.

Time by the clock may be written thus: 5:40.

Write January 14, not 14th of January.

Instead of 8 in. to 10 in., write 8 to 10 in.; and instead of 30° to 40°, say 30 to 40°.

Capitalize the names of geologic formations and periods: Carboniferous rocks, Red Beds of the Trias, Tertiary period.

Points of the compass ordinarily are not capitalized,

except when they refer to a region, as "conditions in the South," "business in the West." This applies also to their derivatives eastern, western, etc., as "in western Colorado," "in southern California"; but "on the Eastern seaboard," "according to Western methods."

Always capitalize State when it refers to a State of the Union (America) or of the Commonwealth (Australia); thus "a state of uncertainty" or "a state of inebriety," but "the State of Montana," "the State of New South Wales," and "the State of Sonora." This rule applies to Territory also, as "the Territory of Alaska."

Capitalize Federal when it refers to the Government, also Empire, Government, Nation, and Republic when they are employed specifically, as: "The resources of the Government," "the future of the Nation," "the wealth of the southern Republic"; but "the republic of letters."

Proper names that have become trade terms are not capitalized. For instance, Bessemer is capitalized only as the name of a man or a town; we speak of bessemer steel, bessemer process. The same rule holds good in portland cement, plaster of paris, german silver, muntz metal, babbitt metal, china clay.

In geographical names the capital is not required for the last member except when important, thus, we have Hudson river but Atlantic Ocean; Delaware bay, but Rocky Mountains. County, lake, valley, basin, and river should not be capitalized, but it is proper to write Coast range, Great Basin, Front range, Great Lakes.

Where the name of a company is not given in full, use a lower case c, as: The Smith company, the North Pacific company. When given in full, a capital C is required, thus: The Smith Smelting & Mining Co., the North Pacific

Railroad Company. Also 'the Company' when referring to a particular company, the full name of which has been previously given.

Employ italics to signify foreign words: "The property covered 32 *pertenencias.*" "The *oficinas* in Chile." "It was a case of *sauve qui peut.*" Names of ships, newspapers, and periodicals go in italics: "The *Baltic* sailed today." "*The Times* states that." "You will see it in the *North American Review.*"

Preventive	not	preventative
Supposititious	"	suppositious
Partly	"	partially, when meaning in part
Reagent	"	re-agent
Reinforce	"	re-enforce
Farther	"	further, in speaking of distance
Delimit	"	deliminate
Persistent	"	permanent, as applied to ore
Except	"	excepting

"**As far as** is applied to undoubted facts, thus: "He went as far as Denver."

So far as is used before clauses containing a statement of doubt or varying fact, thus: "So far as known the ore is easy to treat by cyanidation."

Use English whenever possible, when writing in English.

Thus it is better not to write	**e.g.**	but	**for example**
" " "	**viz.**	"	**namely**
" " "	**i.e.**	"	**that is**
" " "	**via**	"	**by way of**
" " "	**vice versa**	"	**the reverse**
" " "	**in situ**	"	**in place**

In choosing between the use of the terminations **ic** and

ical, as in geologic and geological, it is well to adopt the practice of restricting the first to natural phenomena, relations, conditions, and products, while the second is used in designating the works of man, as in research, literature, speculation. So that we get:

Geologic formation	Geological survey
Geologic structure	Geological map
Electric energy	Electrical machine
Geographic conditions	Geographical bulletin

The following are correct:

Acquiesce **in**	Disagree **with**
Adapted **to**	Favorable **to**
Averse **to**	In view **of**
Compare **with**	Necessary **to**
Consist **in** gives a definition	Necessity **for**
Consist **of** gives a composition.	Need **of**
Content **with**	Oblivious **of**
Contrast **with**	Tamper **with**
Differ **from**	Tinker **at**
Different **from**	With a view **to**

Use **upward, downward, toward,** omitting the unnecessary **s.**

In speaking of the strike of veins, it is not necessary to give the complementary point of the compass. Thus: "The lode strikes northwest," not 'northwest-southeast.' The 'southeast' is an obvious inference.

THINGS TO AVOID.

Do not begin a paragraph with a present participle, lest you flounder ere the close.

Reject **pristine, erstwhile,** and **festive.** They mark the last stage of journalistic vulgarity.

Speak not of the Phoenix and his ashes, nor of the Augean stables, nor of a pilgrimage to Mecca, nor of the labors of Hercules, for such allusions have been worn threadbare long ago.

Avoid dashes and parentheses, which to the reader are as hurdles to a weary runner.

Abstain from italics; let your statements be emphatic without them. Italics, like the underlining in a school-girl's letter, are apt to be over-worked. Reserve them for special occasions.

GOOD AND BAD WRITING.

It is evident that most writers try to economize the mental effort of the writer, not the reader. Bad writing is generally due to sheer laziness, simply mental and physical sloth. It is easier to be verbose than to be terse; it is less trouble to write than to think. A writer who is explicit has taken trouble; the man who is vague assumes that the reader "will know what I mean." But he won't. Hence much trouble. Poor writing calls forth bad language.

Huxley said that the *ars artium*, the greatest of all arts, was to be able to say: "I do not know." To distinguish between what we know and what we think we know is the beginning of knowledge. This applies to writing. The worst performances in print are made by the men who mix fact with fancy, their knowledge with their ignorance, the things they apprehend with the things they suppose, the crystal and the cloud, neither clear water nor solid land, but a morass into which the farther you go the worse your plight.

To young writers it is well to say: Separate what you know at first hand about your subject from what you have learned at second hand, keep the fact distinct from the theory, not that one is necessarily better than the other, but they thrive best when kept apart. Barrett Wendell says truly: "To be clear in narrative, or in exposition, or in argument, or in any kind of discourse whatever, we must evidently proceed from what is known to what is unknown." And the method, being logical, is also that followed naturally by the reader, whose mental processes reflect the activities within the writer's brain—

and the more of it the writer gives to his work, the less the reader will have to consume.

Unpractised writers usually begin an article with one or two paragraphs of valueless generalization, mere wordiness preparatory to an explicit statement, like the tuning of violins before a symphony. The musician cannot help it because the strings of his instrument will not stay taut; they must be tightened to preserve the pitch of the violin. The writer, on the contrary, even if he goes through a preliminary tuning with his pen, need not inflict his reader with the result of such clumsy flourishes; he can delete, and start at the real beginning of his literary effort. And when it is over, there is no need to mask his retreat, like a cuttle-fish, with an inky discoloration of the clear waters of thought. Those who begin with unnecessary tunings are apt to end with gratuitous discords, a wordy introduction is apt to be balanced with a verbose conclusion. Spare your reader both, get to the heart of your subject without loss of his mental energy, and when you have said what you want to say, stop—neither abruptly nor diffusely, but in a frank and friendly fashion that is as polite as it is prompt.

In preparing to write on any subject, it is well to turn it over in the mind, and then to make a list of headings, which stand for separate ideas. If these are put on cards or slips of paper, they can be arranged and re-arranged until the sequence appears logical; if logical, it will be expressive, that is, effective from the reader's point of view. In the course of selecting and shifting the headings, new thoughts will be suggested and the whole matter put into shape. For the act of writing precipitates

thought, transforming amorphous ruminations into crystalline ideas.

Barrett Wendell has said eloquently that "whatever our subject-matter, our task is to translate the evanescent immaterial realities of thought and emotion into written words. No matter how humble our task may seem, we are really performing, well or ill, an act of creative imagination." Hence the pleasure of the writer who knows that he has, in some sort, transferred to paper the thought that was vibrant in his mind; it is like the delight of the musician who strikes a true chord and feels the reverberations tingle through every pulse. At best, written language is clumsy; it lacks the tones and undertones, the expression and gesture, of the spoken word. Most writing stands for but a fraction of the thought that brought it into being; by the time the words have impinged upon the sight and intelligence of the reader, a large part of the warm life that they had when uttered by the writer has shriveled and grown cold. Only now and then does a man arise, like Huxley or Ruskin, with such a mastery of the pen as to transform the immaterial thought into sculptured writing that glows with vivid life, like the tinted marbles of the Greeks; then indeed does man rise in proud superiority over the dumb brutes, for the constructive imagination enables him to use the clumsy symbols of his speech and from them elaborate a vehicle of thought by which the experiences and sensations of a fleeting today are transmitted to his descendants in a distant tomorrow. Mortal, he becomes immortal; created, he becomes a creator.

PARTING ADVICE.

1. Have something to say; then say it.

2. When uncertain as to your grammar or phrasing, re-write the sentence or paragraph.

3. But do not tinker at a doubtful sentence; re-construct it thoroughly.

4. Avoid the use of words the meaning of which is doubtful to you.

5. Make your meaning clear; then consider style.

6. **Remember the reader.**

A PLEA FOR GREATER SIMPLICITY IN THE LANGUAGE OF SCIENCE.*

By T. A. RICKARD.

Scientific ideas are with difficulty soluble in human speech. Man, in his contemplation of the flux of phenomena at work all about him, is embarrassed by the want of a vehicle of thought adequate for expression, as a child whose stammering accents do not permit him to tell his mother the new ideas which suddenly crowd upon him when he meets with something alien to his experience.

Our knowledge of the mechanism of nature has been undergoing a process of growth, much of which has been sudden. It is not surprising, therefore, that the incompletely formed ideas of science should become translated into clumsy language and that inexact thinking should be manifested by vagueness of expression. This inexactness is often veiled by the liberal use of sonorous Greek-Latin words.

The growth of knowledge has required an increase in the medium of intellectual exchange. New conceptions have called for new terms. Sir Courtenay Boyle has pointed out that the purity of a nation's coinage is properly safeguarded, while the verbal coinage of its national language is subject to no control. Specially qualified persons prepare the standards of gold and silver. This insures the absolute purity of the measures of commercial

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exchange and gives the English sovereign and the American gold-piece, for example, an assured circulation along all the avenues of commerce. It is not so with the standards of speech. The nation debases its language with slang, with hybrid and foreign words, the impure alloys and the cheap imports of its verbal coinage, mere tokens that should not be legal tender on the intellectual exchanges. France has an academy which in these matters has much of the authority given to the Mint, whose assayers test our metal coins; but in our country the mintage of words is wholly unrestricted, and, as a consequence, the English language, circulating as it does to all the four corners of the globe, has received an admixture of fragments of speech taken from various languages, just as the currency given to the traveler in exchange at the frontier, where empires meet, bears the mark of several governments and passes with an equally liberal carelessness.

Science ignores geographical lines and bemoans the babel of tongues which hinders the free interchange of ideas between all the peoples of the earth. Nevertheless, the international character of technical literature is suggested by the fact that three languages, French, German, and English, are practically recognized as the standard mediums of intellectual exchange. One of these affords the most lucid solvent of thought, another is the speech of the most philosophical of European people, and the third goes with world-wide dominion, so that each has a claim to become the recognized language of science. The brotherhood of thinking men will have been fully recognized when all agree to employ the same tongue in their intercourse, but such a "far-off divine event" is not within the probabilities of the present, consequently there re-

mains only for us to make the best of our own particular language and to safeguard its purity, so that when it goes abroad the people of other countries may at least be assured that they are not dealing with the debased coinage of speech.

Barrie has remarked that in this age the man of science appears to be the only one who has anything to say—and the only one who does not know how to say it. It is far otherwise in politics, an occupation that numbers among its followers a great many persons who have the ability for speaking far beyond anything worth the saying that they have to say. Nor is it so in the arts, the high priests of which, according to Huxley, have "the power of expression so cultivated that their sensual caterwauling may be almost mistaken for the music of the spheres." In science there is a language as of coded telegrams, by the use of which a limited amount of information is conveyed through the medium of six-syllabled words. Even when not thus overburdened with technical terms it is too often the case that scientific conceptions are conveyed in a raw and unpalatable form, mere indigestible chunks of knowledge, as it were, which are apt to provoke mental dyspepsia. Why, I ask, should the standard English prose of the day be a chastened art and the writing of science, in a great scientific era, merely an unkempt dressing of splendid ideas? The luminous expositions of Huxley, the occasional irradiating imagery of Tyndall, the manly speech of Le Conte, and of a very few others, all serve simply to emphasize the fact that the literature of scientific research as a whole is characterized by a flat and ungainly style, which renders it distasteful to all but those who have a great hunger for learning.

To criticism of this sort the professional scientist can reply that he addresses himself not to the public at large, but to those who are themselves engaged in similar research, and he may be prompted to add to this the further statement that he cannot pitch the tone of his teachings so as to reach the unsensitive intelligence of persons who lack a technical education. Furthermore, he will claim that he cannot do without the use of the terms to which objection is made. However, in condemning the needless employment of bombastic words of classical origin, in place of plain English, I do not wish to be understood as attacking all technical terms. They are a necessary evil. Some of them are instruments of precision invented to cover particular scientific ideas. Old words have associations which sometimes unfit them to express new conceptions and therefore fresh words are coined. The complaint lodged against the pompous and ungainly wordiness of a large part of the scientific writing of the day is that it is an obstacle to the spread of knowledge.

Let us consider the subject as it is thus presented. In the first place, does the excessive use of technical terms impede the advance of science? I think it does. It kills the grace and purity of the literature by means of which the discoveries of science are made known. Ruskin, himself a most accurate observer of nature, and also a geologist, said that he was stopped from pursuing his studies "by the quite frightful inaccuracy of the scientific people's terms, which is the consequence of their always trying to write mixed Latin and English, so losing the grace of the one and the sense of the other." But grace of diction is not needed, it may well be said; that is true, and it is also true that a clear, forceful, unadorned mode of

expression is more difficult of attainment and more desirable in the teaching of science than either grace or fluency of diction. One must not, as Huxley himself remarks, "varnish the fair face of Truth with that pestilent cosmetic, rhetoric," and Huxley most assuredly solved the problem of how to avoid rhetorical cosmetics and yet convey deep reasoning on the most complex of subjects in addresses that are not only as clear as a trout stream, but are also brightened by warm touches of humanity, keen wit, and the glow of his own courageous manhood. Nevertheless, though clearness of expression be the first desired, yet grace is not to be scorned. When you have a teaching to convey, it is well to employ all the aids that will enable you to get a sympathetic hearing. Man lives not by bread alone, much less by stones. He likes his mental food garnished with a sauce. Let the cooking be good, of course, but a *chef* knows the value of a *garniture*.

Our language is capable of a grace and a finish greater than we give it credit. That it is possible to write on geology, for instance, in the most exquisitely simple English has been proved by Ruskin, whose 'Deucalion' and 'Modern Painters' contain many pages describing accurately the details of the structure of rocks and mountains, and dealing with their geological features in language marked by the most sparing use of words that have not an Anglo-Saxon origin.

The next aspect of the enquiry is whether the language of science, apart from the view of mere grace of style in literature, is not likely, in its present every-day form, to delay the advance of knowledge by its very obscurity. Leaving the reader's feelings out of the argument, for the present, it seems obvious that the whole purpose of science,

namely, the search after truth, which is best advanced by accuracy of observation and exactness of statement, is hindered by a phraseology that sometimes means very much but often means very little, and, on the whole, is most serviceable when required as a cloak for ignorance. To distinguish between what we know and what we think we know, to comprehend accurately the little that we do know, surely these are the foundations of scientific progress. If a man knows what a thing really is, he can say so, describing it, for example, as being black or white; if he does not know, he masks his ignorance by stating in a few Greek or Latin terms that it partakes of the general quality of grayness. Writers get into the habit of using words that they do not clearly understand themselves and that, as a consequence, must fail in conveying an exact meaning to their readers. Many persons who possess only the smattering of a subject are apt to splash all over it with words of learned sound, which are more quickly acquired, of course, than the reality of knowledge. Huxley said that if a man does really know his subject "he will be able to speak of it in an easy language and with the completeness of conviction with which he talks of an ordinary every-day matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up." If any scientific writer should complain that simplicity of speech is impracticable in dealing with essentially technical subjects, I refer him to the course of lectures delivered by Huxley to workingmen, lectures which conveyed original investigations of the greatest importance, in language that was as easily understood by his audience as it was accurate when regarded from a purely professional standpoint.

Science has been well defined as "organized common sense"; let us then express its findings in something better than a mere jargon of speech and avoid that stupidity which Samuel Johnson, himself an arch-sinner in this respect, has fitly described as "the immense pomposity of sesquipedalian verbiage." George Meredith, a great mint-master of words, has recorded his objection to "conversing in tokens not standard coin." Indeed the clumsy Latinity of much of our scientific talk is an inheritance from the schoolmen of the past; it is the degraded currency of a period when the vagaries of astrology and alchemy found favor among intelligent men.

Vagueness of language produces looseness of knowledge in the teacher as well as the pupil. Huxley, in referring to the use of such comprehensive terms as 'development' and 'evolution,' remarked that words like these were mere "noise and smoke," the important thing being to have a clear conception of the idea signified by the name. Examples of this form of error are easy to find. The word 'dynamic' has a distinct meaning in physics, but it is ordinarily employed in the loosest possible manner in geological literature. Thus, the origin of a perplexing ore deposit was recently imputed to the effects produced by the "dynamic power" that had shattered a certain mountain. 'Dynamic' is of Greek derivation and means powerful, therefore a 'powerful power' had done this thing; but in physics the word is used in the sense of active, as opposed to 'static' or stationary, and it implies motion resulting from the application of force. In the case quoted, and in many similar instances, the word 'agency' or 'activity' would serve to interpret the hazy idea of the writer, and there is every reason to infer, from the context, that he

substituted the term 'dynamic power' merely as a frippery of speech. It is much easier to talk grandiloquently about a 'dynamic power,' which perpetrates unutterable things and reconstructs creation in the twinkling of an eye, than it is to make a careful study of a region, trace its structural lines, and decipher the relations of a complicated series of faults. When this has been done and a writer uses comprehensive words to summarize activities which he has expressly defined and described, then indeed he has given a meaning to such words and he has a right to use them.

In this connection it is amusing to remember how Ruskin attacked Tyndall for a similar indiscretion. The latter had referred to a certain theory, which was in debate, and had said that it, and the like of it, was "a dynamic power which operates against intellectual stagnation." Ruskin commented thus: "How a dynamic power differs from an undynamic one, and, presumably, also, a potestatic dynamis from an unpotestatic one—and how much more scientific it is to say, instead of—that our spoon stirs our porridge—that it 'operates against the stagnation of our porridge.' Professor Tyndall trusts the reader to recognize with admiration."

Among geological names there is that comfortable word 'metasomatosis' and its offspring of 'metasomatic interchange,' 'metasomatic action,' 'metasomatic origin,' etc., etc. To a few who employ the term to express a particular manner in which rocks undergo change, it is a convenient word for a definite idea, but for the greater number of writers on geological subjects it is a wordy cloud, a nebular phrase, which politely covers the haziness of their knowledge concerning a certain phenomenon. When you

don't know what a thing is, call it a 'phenomenon'!

Instances of mere vulgarity of scientific language are too numerous to mention. 'Auriferous' and 'argentiferous' are ugly words. They are unnecessary ones also. The other day a metallurgical specialist spoke of 'auriferous amalgamation' as though any process in which mercury is used could be gold-bearing unless it were part of the program that somebody should add particles of gold to the ore under treatment. A mining engineer, of the kind known to the press as an expert, described a famous lode as traversing "on the one hand a feldspathic tufaceous rock" and "on the other hand a metamorphic matrix of a somewhat argillo-arenaceous composition." This is scientific nonsense, the mere travesty of speech. To those who care to dissect the terms used it is easily seen that the writer of them could make nothing out of the rocks he had examined save the fact that they were decomposed, and the rock which he described last might have been almost anything, for all he said of it; since his description, when translated, means literally a changed matter of a somewhat clayey-sandy composition, which, in Anglo-Saxon is m-u-d! The 'somewhat' is the one useful word in the sentence. Such language may be described in the terms of mineralogy as metamorphosed English pseudomorphic after blatherumskite. Some years ago, when I was at a small mine near Georgetown, in Colorado, a professor visited the underground workings and was taken through them. He immediately began to make a display of verbal fireworks, which bewildered the foreman and the other miners whom he met in the mine—all save one, a little Cornishman, who, bringing him a bit of clay that accompanied the walls of the lode, said to him, "What

do 'ee call un, you?'' The professor replied, ''It is the argillaceous remnant of an antediluvian world.'' Quick as a flash came the comment, ''That's just what I told me pardner.'' He was not deceived by the vapor of words.

Next consider the position of the reader. It is scarcely necessary at this date to plead for the cause of technical education and the generous bestowal of the very best that there is of scientific knowledge. The great philosophers of that New Reformation which marked the era of the publication of 'The Origin of Species' have given most freely to all men of their wealth of learning and research. When these have given so much we might well be less niggardly with our small change and cease the practice of distributing, not good wholesome intellectual bread, but the mere stones of knowledge, the hard fossils of what were once stimulating thoughts. In the ancient world the Eleusinian mysteries were withheld from the crowd and knowledge was the possession of a few. Do the latter day priests of science desire to imitate the attendants of the old Greek temples and confine their secrets to a few of the elect by the use of a formalism which is the mere abracadabra of speech? Among certain scientific men there is a feeling that scientists should address themselves only to fellow scientists, and that to become an expositor to the unlearned is to lose caste among the learned. It is the survival of the narrow spirit of the dark ages, before modern science was born. There are not many, however, who dare confess to such a creed, although their actions may occasionally endorse it. On the whole, modern science is nothing if not catholic in its generosity. ''To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the prob-

lems of life" was the avowed purpose of the greatest of the philosophers of the Victorian era.

There are those who are full of a similar good-will, but they fail in giving effect to it because they are unable to use language that can be widely understood. In its very infancy geology was nearly choked with big words, for Lyell, the father of modern geology, said, seventy years ago, that the study of it was "very easy, when put into plainer language than scientific writers choose often unnecessarily to employ." At this day even the publications of the Geological Surveys of the United States and the Australian colonies, for example, are occasionally restricted in usefulness by erring in this respect, and as I yield to none in my appreciation of the splendid service done to geology and to mining by these Surveys, I trust my criticism will be accepted in the thoroughly friendly spirit with which it is offered. It seems to me that one might almost say that certain of these extremely valuable publications are 'badly' prepared because they seem to overlook the fact that they are, of course, intended to aid the mining community in the first place, and the public, whether lay or scientific, only secondarily. From a wide experience among those engaged in mining I can testify that a large part of the literature thus prepared is useless to them, and that no one regrets it more deeply than they, because there is a marked tendency among this class of workers to appreciate the assistance which science can give. Take, for example, a sentence like the following, extracted from one of the recent reports of the U. S. Geological Survey: "The ore forms a series of imbricating lenses, or a stringer lead, in the slates, the quartz conforming as a rule to the carunculated schistose structures,

though occasionally breaking across laminae, and sometimes the slate is so broken as to form a reticulated deposit." This was written by one of our foremost geologists and, when translated, the sentence is found to convey a useful fact, but is it likely to be clear to anyone but a traveling dictionary? A thoroughly literary man might know the exact meaning of the two or three very unusual words which are employed in this statement, but the question is, will it be of any use whatever even to a fairly educated miner, or be understood by those who pay for the preparation of such literature, namely, the taxpayers? An example of another kind is afforded by a Tasmanian geologist who recently described certain ores as due to "the effects of a reduction in temperature of the hitherto liquefied hydroplutonic solutions, and their consequent regular precipitation." These solutions, it is further stated, presumably for the guidance of those who wield the pick, "ascended in the form of metallic superheated vapors which combined eventually with ebullient steam to form other aqueous solutions, causing geyser-like discharges at the surface, aided by subterranean and irrepressible pressure." At the same time certain "dynamical forces" were very busy indeed and "eventuated in the opening of fissures"—of which one can only regret that they did not swallow up the author as Korah, Dathan, and Abiram were once engulfed in the sight of all Israel.

It will be well to contrast these two examples of exuberant verbosity because the first befogs the statement of a scientific observation of value, made by an able man, while the second cloaks the ignorance of a charlatan, who masquerades his nonsense in the trappings of wisdom. Here you have an illustration of the harmfulness of this

kind of language, which obscures truth and falseness alike, to the degradation of science and the total confusion of those of the unlearned who are searching after information.

Let the writer on scientific matters learn the derivation of the words he uses and then translate them literally into English before he uses them, and thereby avoid the unconscious talking of nonsense. If he knows not the exact meaning of the terms which offer themselves to his pen, let him avoid them and trust to the honest aid of his own language. "Great part of the supposed scientific knowledge of the day is simply bad English, and vanishes the moment you translate it," says Ruskin. The examples already given will illustrate this. "Every Englishman has, in his native tongue, an almost perfect instrument of literary expression," so says Huxley, and he illustrates his own saying. Huxley and Ruskin were wide apart in many things and yet they agreed in this. Ruskin proved abundantly that the language of Shakespeare and the Bible can be used as a weapon of expression keen as a Damascus sabre when it is freed from the rust of classic importations, which make it clumsy as a crowbar.

There is yet another reason against the excessive use of Greek-English words, in particular. Greece is not a remnant of extinct geography, but an existing land with an active people and a living language. The terms that paleontology has borrowed from the Greek may be returned by the Greeks to us. And, as Ruskin points out, "What you, in compliment to Greece, call a 'Dinotherium,' Greece, in compliment to you, must call a 'Nasty-beastium,' and you know the interchange of compliments can't last long."

In all seriousness, however, is it too much to ask that

such technical terms as are considered essential shall not be used carelessly, and that in publications intended for an untechnical public, as are most government reports, an effort be made to avoid them and, where unavoidable, those which are least likely to be understood shall be translated in foot-notes. Even as regards the transactions of scientific societies, I believe that those of us who are active members have little to lose and much to gain by confining the use of our clumsy terminology to cover ideas which we cannot otherwise express. By doing so we shall contribute, I earnestly believe, to that advancement of science which we all have at heart.

In furtherance of this principle we must remember that language in relation to ideas is a solvent, the purity and clearness of which effect what it bears in solution. Whewell, in 'The Philosophy of the Inductive Sciences,' has expressed this view of the matter with noble eloquence. "Language," he said, "is often called an instrument of thought, but it is also the nutriment of thought; or rather, it is the atmosphere in which thought lives; a medium essential to the activity of our speculative powers, although invisible and imperceptible in its operation, and an element modifying, by its qualities and changes, the growth and complexion of the faculties which it feeds."

In considering the subject from this standpoint, there is borne in upon the mind a suggestion that carries our thought far beyond the confines of the matter under discussion. Such power of speech as man possesses is a faculty which appears to divide him from all other living things, while at the same time the imperfection of it weighs him down continually with the sense of an essential frailty. To be able to express oneself perfectly would be

divine, to be unable to make oneself understood *is* human. In 'Man's Place in Nature,' Huxley points out that the endowment of intelligible speech separates man from the brutes which are most like him, namely, the anthropoid apes, whom he otherwise resembles closely in substance and in structure. This endowment enables him to transmit the experience which in other animals is lost with each individual life; it has enabled him to organize his knowledge and to hand it down to his descendants, first by word of mouth and then by written words. If the experience thus recorded were properly utilized, instead of being largely disregarded, then man's advancement in knowledge and conduct would enable him to emphasize much more than it is permitted him at present, his superiority over the dumb brutes. Considered from this standpoint, language is a factor in the evolution of the race and an instrument that works for ethical progress. It is a gift most truly divine, which should be cherished as the ladder that has permitted of an ascent from the most humble beginnings and leads to the heights of a loftier destiny, when man, ceasing to stammer forth in accents which are but the halting expression of swift thought, shall photograph his mind in the fulness of speech, and, neither withholding what he wants to say nor saying what he wants to withhold, shall be linked to his fellow by the completeness of a perfect communion of ideas.



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COURTENAY DE KALB, - ASSOCIATE EDITOR
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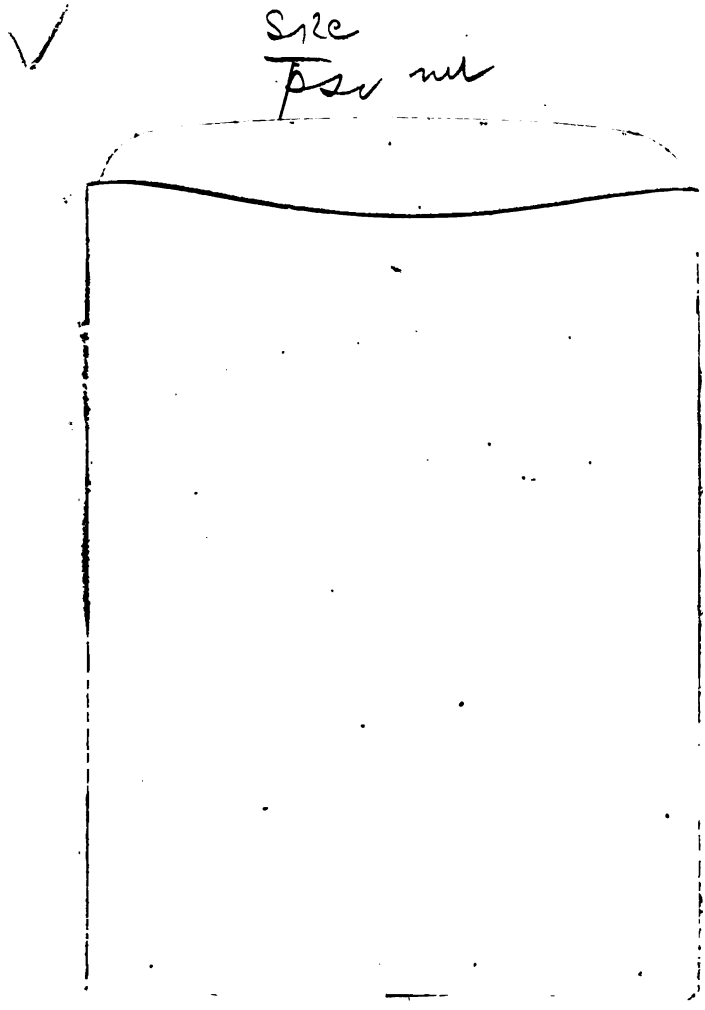
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